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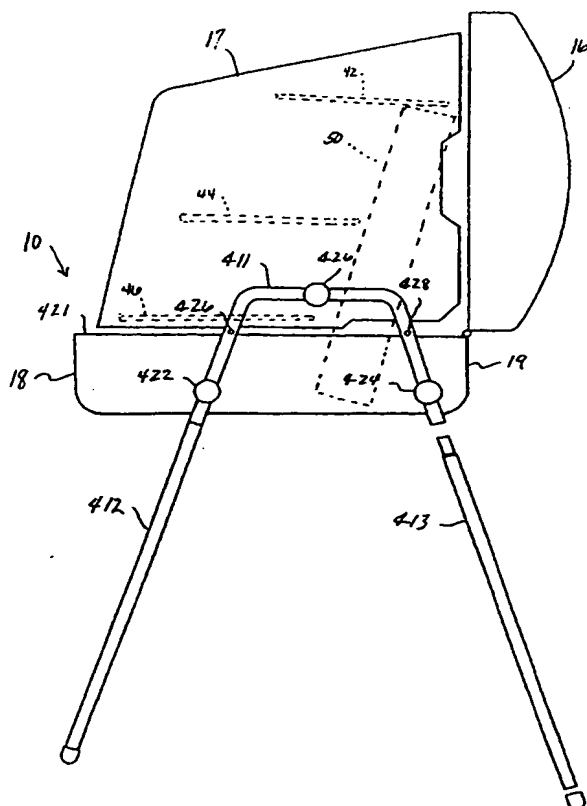
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[Continued on next page]

(54) Title: VERTICAL HEARTH BARBECUE GRILL



(57) Abstract: A gas-fired or briquette-burning barbecue grill (10) that produces high BTUs from a removable, vertical firebox (50) that may be backwardly inclined so as to provide a combination of direct and indirect heating. Multiple cooking grids (42, 44) positioned at various vertical levels provide an enormous cooking area for flame-broiling, grilling, and roasting. Inclination minimizes ash avalanche during briquette burning and also increases the effective heating area applied to multiple cooking grids (42, 44). A top grid (42) located directly over the firebox provides a surface high-temperature cooking (i.e., direct heating). A pair of opposed insulated sidewalls (17) one on each side of a central heating area help confine heat in and about the cooking grids and may also support a removable main cooking grid (46).

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## VERTICAL HEARTH BARBECUE GRILL

### Background of the Invention

In light of the design, construction, and limitations of prior vertical grilling devices, problems confronted and/or addressed by the present invention include but are not limited to achieving simultaneously multi-temperature and multi-mode cooking (direct and indirect heating), simultaneous underside and laterally cooking, thermal insulation from extreme firebox heat, ash containment and removal for easy clean-up, channeling and trapping grease drippings; strength and rigidity of deployed grill assembly, convertibility to an oven, portability and transportability of a collapsed grill, stability of a grill assembly when fully deployed, utilization of waste heat for steam, hot water, or powering grill implements, provide detachable legs which elevate the grill to sufficient height, and/or containment of grill parts for transport and storage.

In view of the above-stated problems, it is an objective of the present invention to provide improved grilling, broiling and searing by providing a combination of direct and indirect heating of foodstuffs by utilizing an inclined firebox.

It is also a general objective of the present invention to provide a method of changeably applying direct and/or indirect heating during cooking, grilling, broiling, or barbecuing of foodstuffs on horizontal grids positioned across the face of an inclined firebox.

It is a yet an additional objective of the present invention to augment thermal insulation of an external housing of a vertical barbecue grill by providing an arrangement to displace the fire chamber from rear and vertical walls of the grill assembly and by spacing hot coals in a basket within the firebox.

It is yet another objective of the invention to provide, at least for briquette-burning grills, a firebox that avoids ash avalanche over cooking foods and for providing an ash reservoir within a firebox that may be removed without disturbing other parts of the grill.

It is yet another objective of the present invention to provide a vertical barbecue grill construction enabling convertibility to an oven for baking, roasting, grilling, etc.

It is yet a further objective of the present invention to provide a deployable barbecue grill having a rigid and stable structure in a fully deployed and extended mode.

It is yet an additional objective of the present invention to provide a barbecue grill that is stable against backward tipping due a rearward displacement of the center of gravity when deployed and loaded with charcoal.

It is yet a further objective of the present invention to provide a self-contained vertical barbecue grill assembly that is collapsible for convenient transport, storage, and shipping.

Another object of the invention is to catch grease drippings during barbecuing in order to prevent spoiling of gas burners and/or briquettes, thereby facilitating clean up after barbecuing.

Another object of the invention is to provide routing and/or trapping of cooking effluence during barbecuing.

Other objectives will become readily apparent from the following description.

### **Brief Description of the Drawings**

Fig. 2 is a perspective view of a preferred structure of a collapsible, deployable barbecue grill in deployed mode absent, among other things, a high-temperature firebox and multiple cooking grids.

Fig. 2 depicts an exemplary optional hinged cover for converting the vertical hearth barbecue grill to an oven.

Fig. 3 is a side view of the barbecue grill of Fig. 2 illustrating yet other features including a grease box or trap, a downwardly sloping main cooking grid, an inclined firebox, an exemplary firebox receptacle or support structure, and an ash reservoir in the firebox.

Fig. 4 shows preferred construction details of an exemplary main cooking grid, which includes oppositely facing channels (angles or semi-circular channels), instead of wire rods, that route grease drippings to a trough or grease box located in a frontal portion of the base cavity of the barbecue grill away from burning coals or gas burner flames.

Fig. 5 is a perspective view of a main grid and grease tray disposed in operative relation to the base and side panels of the illustrative barbecue grill.

Fig. 6 depicts a preferred supporting arrangement for the main and mid-level cooking grids, including support structure provided by the side panels.

Fig. 7 depicts an upwardly inclined edge of a cooking grid.

Fig. 8 depicts a preferred structure of the top cooking/flame-broiling cooking grid.

Fig. 9 is a side view of the barbecue grill illustrating inclination of the firebox and provision of a heat shield to protect the finish of the grill.

Figs. 10A and 10 respectively show an exemplary firebox and a slip cover that slips over the firebox for smothering or extinguishing burning briquettes.

Fig. 10C depicts a firebox having a divider, useful for half-loads of briquettes.

Fig. 11 depicts a heat exchanger arrangements adapted for the barbecue grill of the present invention.

Figs. 12A, 12B, 13A, and 13B show alternative arrangements of a heat exchanger and hot water storage tank.

Fig. 14A illustrates a side view a basic improvement provided by the present invention, which includes detachable legs attached to respective side panels and to sides of a vertical barbecue grill;

Fig. 14B depicts a front view of the detachable legs of Fig. 14A.

Fig. 14C is an expanded view of an illustrative interlocking structure of Fig. 14A.

### **Description of Illustrative Embodiments**

Fig. 1 shows an illustrative embodiment of a barbecue grill 10 constructed in accordance with one aspect of the invention, which is trade named "V-Broiler." The grill includes a housing comprising a lower base cavity 12, a top lid 14, and a pair of opposed sidewalls 16a and 16b, preferably made of sheet metal. Some or all of these components may be sand, shell or die casted of steel, or a high-temperature aluminum or other alloy. Top lid 14 includes a series of stiffening ribs 13b, 13b, 13c, and 13d stamped into the sheet metal to reduce warping tendencies when exposed to extreme heat of a firebox. Base cavity 12 includes a lip 11 that mates with a corresponding lip 15 of top lid 14 in sealed relation when the unit is closed. Lips 11 and 15 of the respective base cavity and top lid may be beveled outwardly towards each other to establish therebetween spring-loaded compression sealing when the grill is closed. A two to three degree bevel angle should suffice. Piano hinge 22 pivotally connects the top lid 14 to the base cavity 12, and also assists in sealing the rear edges the top lid and base cavity when closed. Other sealing arrangements as known in the art may also be employed, either by various hinge designs or construction arrangements of mating lips of top lid 14 and base cavity 12. In addition, the base cavity includes brackets (not shown here) attached to the inside thereof for supporting the lower portion of a removable firebox that rests in an inclined position. As stated herein, inclination advantageously provides simultaneous direct and indirect heating of foodstuffs on cooking grids placed in the vicinity thereof. Indirect heat emanates laterally from the vertical hearth of the firebox while direct heating is applied underneath the cooking grid above the heated fuel source.

An optional cover, preferably made of metal, is shown in Fig. 2. When used with the vertical barbecue grill of Fig. 2, it establishes an oven-like enclosure in and about the cooking

area of the grids, which helps with smoke-induced flavoring using an amount of wood chips in the firebox. The cover converts the vertical barbecue grill to a portable oven, which is particularly useful for baking or roasting, and comprises a top portion 21 that is preferably hinged to a frontal portion 26 at junction 28. A piano hinge, as well, may be used here. Top portion 21 may be supported by hooks that rests in slots of the hat channels attached to the sidewalls. The top portion of the cover extends backward to but does not extend over the firebox. Tabs 25a and 25b shown on the right side of the top portion, and corresponding tabs on the left side of the cover, protrude into a space between respective left and right hat channels and sidewalls when the cover engages the respective sidewalls. Stiffening ribs may be stamped into surfaces of the cover to improve rigidity and/or resist warping. A damper 25c is provided to control the internal oven temperature by venting air, and a temperature gage 25d is provided for monitoring temperature. Top portion 21 may also serve as a warming/cooking surface. A handle 27 provides convenient opening and closing of the chamber during cooking without substantial loss of trapped heat.

A set of front legs 30a and 30b, and rear legs 30c and 30d, elevates the barbecue grill to a convenient cooking height, typically thirty to thirty-four inches. The leg pairs swing outwardly front to back, rather than from side to side, in order to improve stability. A tabletop model need not include legs at all but may instead have insulating spacers. A low-profile unit may have shorter legs, e.g., four to ten inches. A non-portable backyard version of barbecue grill 10 need not have folding legs. Fixed legs, instead, may be provided. Further, the legs may be constructed from a variety of materials including tubular/steel, aluminum, wood, etc.

Front leg pair 30a and 30b includes extension members 36a and 36b, if necessary, to obtain sufficient height. The leg extensions may be extendable and retractable within the leg housings and held in place at discretely extended or retracted points using conventional clamps, leg-locks, spring-loaded button-hole mechanisms, or the like. A cross member 31a, preferably comprising a flat metal slat, interconnects leg pair 30a and 30b to provide stability. Although illustrated on the inward side of the legs, slat 31a preferably attaches to the outward side of leg pair 31a and 31b so as to provide unobstructed folding over a retracted rear leg pair 30c and 30d. Rear leg pair 30c and 30d also includes extension members 36c and 36d as well as a cross member support 31b. Similarly, slat 31b preferably attaches to the outward side of leg pair 30c and 30d. One set of legs (either the front or the rear pair but preferably the rear) has a greater distance between them to permit retraction of both sets to the same

plane whereby the cross member slats lie outwardly of the unit when the legs are folded to a retracted position. This arrangement provides a clearance underneath the slats for storing side shelves and/or an oven cover (Fig. 2). A hinge cup 32 and axial pin 34, shown with respect to leg 30b, provide a pivot point and stop for the leg during extension and retraction. To provide stability against backward tipping of the vertical grill, rear leg pair 30c and 30d extend outside the rear plane of the base cavity. Instability or backward tipping tendencies may result from a rearward displacement of the barbecue grill's center of gravity upon loading the firebox.

In a portable model of the barbecue grill 10, the leg pairs are folding and extendable, as shown. Also, the height of the front and rear leg pairs (or insulating spacers if used instead) may differ in length (or height) to provide a forward incline of the base cavity in order to channel grease drippings towards the front of the unit. Inclination channels potentially flammable grease drippings away from the region of the firebox, thus reducing the chance of grease fires. Grease channeling may also be provided by forward inclination established by support members for a main cooking grid, subsequently described, which channels grease drippings to a grease box or grease trough preferably located in the inside front of the base cavity 12. A non-portable model need not have folding legs but may include a base cavity construction that provides the same functionality.

Sidewall 16a pivotally connects to top lid 14 via hinges 20a and 20b, but may as well, be constructed so that it pivots from upper edges of the base cavity 12. Pivoting the sidewall from the top lid, though, advantageously permits a single locking clamp to rigidly fasten the sidewall to the base cavity when deployed and to fasten the top lid to the base cavity when collapsed, as subsequently shown and described. Similar hinging is provided for sidewalls 16b. Each sidewall includes cutouts 17a and 17b, shown in sidewall 16b, for providing air intake for a burning fuel of a firebox insertable in the barbecue grill housing 10. Further, the sidewalls include hat channels 19a and 19b (not shown) spot welded to the inside thereof. The hat channels 19 provide an internal air spacing that provide thermal insulation between the fuel chamber of the firebox and the exterior area of the barbecue grill 10. In addition, the hat channel includes a series of flanges 18a, 18b, and 18c for slideably supporting multiple cooking grids at various heights (and also at various temperatures) across the frontal face of the firebox when inserted into the barbecue grill housing. This arrangement is useful for

interchangeably providing a method of subjecting foodstuffs to direct and indirect heating during cooking. Flange 18a also provides support for and engages a cover, which encloses the area between to sidewalls to create an oven.

The basic structure of the barbecue grill including the sidewalls, base cavity and top lid provides a cooking area generally defined about the base cavity upwardly between the sidewalls. Advantageously, multilevel cooking grids positioned at levels defined by flanges 18a, 18b and 18c provide a variety of different cooking temperatures for various types of foods.

Fig. 3 is a side view showing further details of the preferred structure of Fig. 1. As shown, top lid 14 includes an inner shelf 49 that is spot-welded internally thereof and which provides a flange 49 for supporting the upper portion of the firebox 50 via lip 56 located on the firebox housing. A flange or bracket 57 supports the firebox at a lower end thereof. It should be noted that inclination of the firebox may be provided by a variety of structures, including support by other structures in the base cavity 12, or alternatively, by a supporting structure of the sidewalls. Rather than a pair of brackets 57, a cradle or receptacle that mates or interlocks with the firebox may be provided to support the firebox in an inclined position to achieve the advantages of simultaneously direct and indirect heating.

Firebox 50 preferably comprises a sheet metal housing which includes an ash reservoir or chamber 52 at the bottom thereof. This reservoir advantageously catches ashes in briquette-burning vertical grills, or provides a burner chamber for a gas-fired version (natural gas or propane). Since few, if any, ashes fall into the base cavity, the unit may be conveniently cleaned simply by removing, extinguishing burning charcoal, and/or dumping the ashes from the firebox. A firebox cover designed to close off air supply to burning charcoal may slideably attach (or attach by mating edges) to the firebox housing to extinguish oxidation. As known in the art, clean-up requirements have been a major obstacle to acceptance by many of charcoal-burning grills. Importantly, expended ashes that fall into the reservoir also assist in augmenting thermal insulation between oxidizing briquettes and the firebox housing. Chamber 52 may extend throughout a spacing 53 provided at the rear of the firebox housing.

Preferably, the firebox comprises a wire mesh basket 70 for retaining charcoal briquettes, wood chips (for smoked flavor), or other fuel. In the case of a gas-fire grill, the chamber 52 may house a gas burner for heating stones, rocks or heat retaining briquettes. The burner, though, need not be inside the firebox but may instead be located externally of



the firebox. Further, multiple propane or natural gas burners may be incorporated internally or externally of the firebox. To attain high BTU output and more even heating between upper and lower regions of a gas-fired firebox, burners may be staggered at multiple levels about heat retention briquettes (not shown) either inside (i.e., embedded burners) or outside of the inclined firebox. Also, in one preferred embodiment, basket 70 extends further downwardly into the chamber 52 as shown at 73, and a facing portion 51 of the firebox is reduced in height to provide a greater area of direct exposure of coal grate 70 underneath the main cooking grid 46 so that direct heat may convect and radiate underneath main cooking grid 46. Also, instead of providing a "square" cross-sectional shape of the firebox bottom, as shown, the firebox bottom may be constructed to lie parallel with the bottom of the base cavity, e.g., having a cross-sectional shape similar to the top portion of the firebox.

Top grid 42 is preferably supported by flange 18a, or alternatively, may be pivotally supported by the top lid of the firebox or other structure of the barbecue grill 10. Flanges 18 are punched out of the sheet metal of hat channels 19. Flanges 18b and 18c of hat channel 19a are also sheet metal punchouts and horizontally support a mid-level grill 44 at respective vertical levels. Base cavity 12 includes a flange 61 spot welded to each side thereof for supporting the main cooking grid 46 to provide approximately three degrees (more or less) of forward incline from the rear to the front of the base cavity. The range of inclination of the main cooking grid, i.e. support flange 61, may range between approximately one or two degrees to perhaps as much as five to ten degrees. Higher or lower ranges may be used so as to channel grease dripping away from the firebox and/or towards a grease trap.

From the side view of Fig. 3, cam lock 64 is shown to rigidly fasten sidewalls 16b to the top edge of the base cavity 12. Cam lock 64 also fastens the top lid 14 to the base cavity 12 in tight, rigid mating relation when the barbecue grill is folded down and collapsed. Thus a lock engaging member in the top lid 14 is positioned to engage cam lock 64 when the unit is folded down. A similar locking mechanism for the other side of lid 14 is provided for the opposed sidewall. When fastened in deployed mode, a rigid structure is provided which eliminates "flapping" members when the deployed unit is lifted, moved, or shaken. In essence the cam locks help establish a unitary rigid structure after deployment of the barbecue grill for convenient handling. Cam lock 65 engages a member 65' (Fig. 18) in order to help tighten the seal of top lid 14 against the base cavity 12.

Because the top lid 14 is exposed to extreme heat of the firebox, there is a tendency towards warping of portions of the metal as it expands unevenly. To resist warping, stiffening

ribs are stamped into the sheet metal surface thereof. Further, insulating features of the firebox reduce heat exposure to the top lid, which further helps to minimize warping tendencies. The top lid may also include air passages, but preferably, such passages are provided in the sidewalls to avoid any openings in the barbecue grill housing when stowed and/or transported. Rigid fastening of the sidewalls to the base cavity further reduces warping tendencies.

Fig. 4 is a perspective view of one embodiment of a main cooking grid, which comprises a series of small oppositely facing, linearly overlapping metal channels 46a, 46b, etc. interconnected, e.g., by welding, by a series of rods 47a, 47b (two shown here). Steel or stainless steel channels are preferred since their heat conduction and retention properties assist in cooking. One-half inch channels having a depth of 1/8 to 1/4 inch may be utilized. Opposing channels overlap in the elongated direction. As earlier described, the main cooking grid is inclined downwardly to direct grease runoffs of foodstuffs to a grease catching box or trough which, in turn, route the grease to a box. Inclination may be provided by support guides, or alternatively, by offsets in leg length between the front and rear leg pairs. In addition, close spacing of channels helps to reduce any grease fire that may start from grease entering the base cavity. When positioned in the base cavity, appendages 48a, 48b of the main grid embrace the sides of the firebox so as to catch grease dripping from upper grids.

Referring to Fig. 5, the main grid assembly comprises a top portion 112 and a bottom portion 114, which are joined together by stiffening rods (Fig. 4) between portions 112 and 114 and extending laterally for side to side. Top layer of sheet metal includes a series of slots or cutouts 116 through which grease drippings fall to the lower layer 114. Mounds 117 are disposed between the slots, which may also lie in troughs. Troughs 113 (Fig. 3A) in the lower layer 114 are laterally offset from mounds 117 in the upper layer, which enables reversibility of the cooking grid so that it may be used on either side. The top layer 112 includes a folded over lip in the front thereof, but this may be removed so that the top and bottom layers are substantially the same.

Lower layer 114 includes a series of longitudinally extending troughs 113 disposed beneath the slots 116 of the upper layer. The troughs 113 catch drippings and route them to a grease box 120 disposed along the front edge of the grid assembly due to being supported in an inclined position in a barbecue grill. Grease box 120 may include a number of baffles or upward protrusions (not shown) in the bottom surface to break the flow of grease to reduce the chance of spillage when carrying the grease box for dumping.

Sheet metal stampings 112 and 114 may be porcelain dipped to form a non-stick surface in order to facilitate cleaning. Alternatively, the upper and lower portions 112 and 114 may comprise oppositely facing and laterally offsetting troughs, e.g., a number of parallel small channels or angles, as shown in the related incorporated patent application mentioned above. In the preferred embodiment, the upper and lower portions are disposed relative to each other so that troughs in the lower portion or layer catch vertically falling grease drippings while intervening spaces, perforations, cutouts or slots in the upper and lower portion permit convection of heated air from beneath the cooking grid assembly.

To reduce cost and weight of the assembly, the preferred assembly uses thin sheet metal, e.g., eighteen to twenty gage sheet metal, and a number stiffening rods, e.g., 3/16" diameter, inserted between and traversing the upper and lower layers.

Fig. 6 shows a side panel 16 having an inner wall or hat channel 19a spot-welded or riveted thereto. Inner wall 19a includes slots 19c, 19d that receive rod extension members 42c, 42d of a cooking grid 42, which extends between the side panels laterally across the cooking area. Extension members 42c, 42d protrude into slots 19c, 19d of respective inner walls of the side panels thereby to support the cooking grid in a fixed position in the cooking area across the face of the firebox. Advantageously, extension members 42c, 42d extend in a horizontal plane of the cooking grid 42 so as to attain minimal volume for storing the cooking grid inside the grill when collapsed or folded up. As shown, slots 19c, 19d comprise a horizontal segment that receives the rod extension members and a vertical segment to permit the grid to drop down and lock in position. Alternatively, slots 19c, 19d may comprise an elongated vertical segment only so that rod extensions of grid 42 may extend downwardly, perpendicular to the plane of the grid, to lock when pushed downwardly. This arrangement, however, would necessitate additional storage volume for the grid.

Inner wall 19a of side panel 19 also includes flex tabs 19e, 19f that support by friction grasping a main cooking grid (not shown) across a lower portion of the firebox. Preferably, flexing is achieved by providing vertical cuts in inner wall 19a at opposites sides of each of tabs 19e and 19f, as shown. In addition, rear tab 19f is elevated slightly higher than front tab 19e so as to support the main cooking grid at an inclined position, e.g., about 2°, to help channel grease to a grease tray (not shown) in the front of the grill beneath the main cooking grid. Flex tabs 19e, 19f flex inwardly when side panels are folded against each other when the grill is collapsed, and flex outwardly to grasp the edges of the main grid upon deployment of the side panels.

Fig. 7 depicts a segment of cooking grid 42 having frontal portion 42' inclined upwardly about 5°. This helps to prevent foodstuff from rolling off grid 42 during use. Ideally, the frontal portion 42' has an inclination between five and fifteen degrees. The rear portion of grid 42 may also be bent upwardly, if desired.

The vertical hearth barbecue grill preferably includes multiple cooking grids, including a top grid 43 shown in Fig. 8. Top grid 43 includes a flip-over extension segment 43' adapted to rotate directly over the top of the firebox. When moved to a position over the firebox, this provides a "direct heat" cooking surface useful for searing or simply to provide a direct heating surface for a pot, pan, skillet, etc. When moved away from covering the firebox, briquettes may be added to the firebox. This arrangement advantageously enables refilling the firebox without removing foodstuff from the grid 43. Instead of rotating, the extension segment may be slideably mounted with grid 43 so as to slide between retracted and extended positions.

Fig. 9 depicts a heat shield 60 located inside the dome of lid 14 above firebox 50. Shield 60, preferably comprising stainless steel or porcelain dipped steel, helps protect the finish of dome 14 and also helps to reduce the heat exposure to the portion of the dome 14 directly above the top of the firebox 50. Advantageously, heat shield 60 enables a powder coat finish on the dome 14. Otherwise, it must be porcelain-dipped, which adds to the overall weight to the portable grill. Flexing of shield 60 may be attained by the shield material itself, or by hinging the shield to the dome (not shown). In the embodiment shown, base 14a of shield 60 is fastened to a shelf 13 spanning inside dome 14 so that, when the dome is opened, shield 60 flexes outwardly to extend over the top of firebox 50 and, when the dome is closed against base 12, shield 60 is pushed inwardly. Shield 60 may also be held in place over the firebox by simple fastening means known in the art. Extended protection may also be provided by a liner or shield 61 (shown in phantom) inside dome 14 in order to protect or shield the entire surface of the dome. Shields 60 and 61 may be formed in a single integrated piece.

Fig. 10A shows a vertical firebox 50 that holds briquettes and Fig. 10B, in accordance with an aspect of the present invention, shows an upside down slip cover 51 that slips over the firebox 50 to form substantially an air tight seal that helps extinguish burning coals in firebox 50. The seal is at least sufficient to extinguish coals by minimizing air flow to burning fuel in the firebox. This way, when cleaning up after barbecuing, the covered firebox with coals inside may be placed back into the base cavity 12 and carried away with the user,

instead of dumping hot coal into the environment. After the coals are extinguished, they may then be properly trashed or disposed of.

In a preferred embodiment, firebox 50 includes an inside divider (Fig. 10C) that divides the internal chamber thereof into two compartments, as evident by open windows 52, 53. Windows 52, 53 include expanded metal, wire mesh, grates, or the like for retaining briquettes or other fuel while allowing radiant heat and convection to enter the cooking area. The divider is useful for grilling smaller amounts of foods using a one-half load of briquettes. Firebox 50 measures 14.5" in height by 20" in width by 2.75" in depth, and preferably comprises stainless steel having a thickness of about 0.8 to 1.0 mm, and slip cover 51 has similar dimensions and also preferably comprises stainless steel having a thickness of about 0.4 to 0.6 mm. As illustrated in Fig. 7B, open end 55 of slip cover 51 is beveled outwardly at 56 to facilitate slipping the cover over a slightly smaller open end 54 of firebox 50.

A further improvement is particularly useful with a barbecue grill having a vertical firebox where a laterally positioned heat exchanger and/or power unit is not subjected to grease drippings, food or fuel debris, exhaust or ashes.

Fig. 11 illustrates a portable, vertical hearth barbecue grill including an improvement of the present invention, it be understood that grills having conventional horizontal-type briquette or propane heating may also incorporate the improvement hereof. Barbecue grill 10 of Fig. 1 includes a base housing 12, a pivotally attached upper housing in the form of a dome or lid 14, and a pair of side panels 16 and 18 that are pivotally attached to the side panels. Grill 10 may also include legs (not shown). A vertical firebox, which provides a source of heat from burning charcoal or propane fired briquettes, is not shown here for the sake of convenient illustration. An inventive improvement includes a heat exchanger shown in the form of a coil or tube 320 attached to panel metallic 321 located in a position behind the firebox and inside the dome 14. Preferably, the coil 320 is comprised metal tubing having a relatively high heat transfer coefficient and heat absorption characteristics, such as copper, anodized aluminum, or other metals. Coil 320 may also include conventional fins (not shown), baffles (not shown), or cross member bars (not shown) that assist in heat exchanging. The heat exchanger may also simply comprise a metal plate or other metallic structure having water channels, water passages, or other structure that permits transfer of heat to the water.

An funneling device, such as a cup connects to an input of coil 320. This helps channel fresh water to fill the coil. An discharge end 324 of tube 320 provides heated water discharged from the coil 320 after it passes in heat transfer proximity of a heated firebox.

When the firebox is fully fired, e.g., about eight pounds of charcoal fully burning, twenty feet of copper tubing 3/16" inside diameter coil spaced about two inches from the rear of the firebox heats 60° F supply water to about 120° F at a flow rate of about ten ounces per minute. Heating can be improved by positioning the coil closer to the fire box, decreasing the flow rate, providing additional coil length, improving the heat absorption or transfer efficiency of the coil (e.g., adding fins, baffles, cross member rods, etc.), or a combination of these. Alternatively, grill 10 may include a holding tank positioned in heat transfer proximity of the firebox in order to heat a reservoir of water for subsequent consumption, rather than heating during flow through a heat exchanger. The surface of tube 320 may be cut open at various locations to vent pressurized steam with initial contact with water.

Figs. 12A and 12B show side and front views of a portable, vertical hearth barbecue grill having a vertical firebox that heats water both in a tank 328 and as water flows through coil 320. In Fig. 12A, gas-fired briquettes in firebox 50 are heated by a gas source 332, e.g., propane or natural gas, and gas burner 334 located at a lower portion of firebox 50. Water tank 328 located near an upper portion of firebox 50 is filled with supply water via funnel device 322 and, during firing of the briquettes, becomes heater by radiant and convection heat from firebox 50. A heat exchanger coil 320, although not necessary, communicates with tank 328 to further heat gravity-fed supply water flowing through coil 320 downwardly in lateral proximity of firebox 50 to a discharge port 324. A manually operated check valve or tap 326 controls the flow a water.

Figs. 13A and 13B show side and front views of a charcoal-burning, vertical hearth barbecue grill having an inclined firebox 50 filled with briquettes. In the illustrated embodiment, firebox 30 has a charcoal capacity of about six to eight pounds. Inclination reduces the likelihood of ashes falling onto food cooking grids or surfaces (not shown). A shelf 13 inside dome 14, among other things, helps provide a heated compartment or chamber behind the heated firebox 50 where heat exchanger coil 320 is located. The heated chamber further confines heat energy in and about the heating coil 320, which may additionally include fins or absorption rods to improve heat absorption and transfer capacity. As previously described, a funneling device or cup 322 assists in filling coil 320 with water, which becomes heated as it is gravity fed to tank 328. Tank 328 is laterally disposed near a lower portion of firebox 50 and hold a heated supply of water until discharged through discharge tube 324 by manually operated check valve 326.

As with Figs. 12A and 12B, the tank in Figs. 13A and 13B may be located at any position in or out of heat transfer proximity of the firebox. As indicated above, water may be heated using the tank 328 without the heat exchanger coil 320 or by the heat exchanger coil without the tank 328. The coil and the tank may be used in combination to heat water and/or store hot water once heated.

The invention also provides a method of producing hot water from a barbecue grill including providing a source of heat in the barbecue grill, providing a heat exchanger (with or without fins or heat absorption elements) in proximity to the source of heat, passing water through or about a heat exchanger, and discharging heated water from the heat exchanger. Another embodiment of the method includes providing a tank or reservoir in a barbecue grill, filling the tank with water, subjecting the tank to a source of heat, and extracting hot water from the tank with or without a check valve. The improvement further includes producing steam for cooking foods in a barbecue grill, comprising the steps of providing a water tank in a barbecue grill (vertical or horizontal), filling the tank with water, subjecting the tank to a source of heat, and directing steam generated by said tank upon a food cooking region of the barbecue grill. In addition, the improvement includes a method of producing power comprising providing a source of heat in said barbecue grill, providing a pressure tank in said barbecue grill, filling said tank with water or other fluid, pressurizing said tank by subjecting said tank to said source of heat, and converting steam or gas vapor produced by said tank to mechanical or electrical power.

Another problem encountered and addressed during development of the present invention was directed to providing leg members that fit inside a relatively small housing of the grill or shipping container, that quickly and firmly attaches to the grill housing, that provide stability on non-planar surfaces, that provide a handle straddling the grill's front-to-back center of gravity, and that provides stability against backward tipping when the grill's load is shifted.

In a preferred embodiment of the invention, these problems were solved by providing detachable leg member on each side of the grill housing in the form of a tubular frame where a top portion of the leg member interlocks with the sides the grill, e.g., an elongated flange or slot opening on each side of the grill housing and a fastener, e.g., a screw bolt, clamp, cam lock, etc., that fastens the detachable leg member to the grill housing such that the appending ends of the legs extend rearward of the range of the grill's front-to-rear center of gravity. In another aspect of the invention, the grill housing comprises sheet metal possessing a

minimum degree of torsional flexibility about an axis that extends from side-to-side so as to permit self-leveling of four legs. In addition, to achieve compactness, each leg may be segmented and/or hinged so that portions thereof fit inside the grill housing. Other implements, such as a protruding handle or a side shelf, may be held in place by friction clamping or interlocking with the leg members. The legs may take on a variety of other shapes, including an A-frame, a U-shape, a partial parallelogram, or a combination thereof.

Figs. 14A, 14B, and 14C show an improvement of the invention which includes an upper segment or side bar 11 along with detachable legs 412 and 413 for each side of the barbecue grill. The grill including a housing 12, a lid or dome 16, and a pair of side panels 17 that are pivotally hinged to the dome 16. A side bar 411 attaches to respective sides of a barbecue grill housing 10 and extends upwardly to secure side panel 17. Side bar 411 is shown separated from legs 412 and 413 in order to more easily fit inside the grill 10, but desired, their structure may be integrated in a single piece comprising elements 411, 412 and 413. The legs comprise, preferably, tubular metal such as steel, aluminum, or other metal. The cross-sectional shape preferably is circular, square, or rectangular. When segmented in the manner shown, a "vacuum cleaner" like hose attachment may be provided to interconnect the legs to side bar 411 where the diameter of the tubular end of legs 412 and 413 is reduced. Attachment of side bar 411 to the side of base housing 18 may be made by many means known in the art, but for portable models of grill 10 where the legs fit inside base 18, clamping, bolting, or latching is preferred for quick attachment.

Fig. 14B shows a knurled head screw 422 and hook pin 426 protruding through side bar 411 and fastening respectively to a nut 423 welded inside the base housing 18 and to a hole in lip 419 on the top edge of base housing 18. The head of knurled head preferably has a diameter of one-and-a-half inches to enable sufficient hand-torque to fasten side bar 411 to base housing 18. A knob, spring-loaded clamp, or other clamping mechanism, instead, may also be employed. For added stability, the side bar 411 is beveled outwardly at an angle  $\alpha$  of about five degrees, more or less, so that legs 412 and 13 when deployed, are angled outwardly from respective sides of the grill 10. An end 427 of pin 426, as more clearly depicted in Fig. 14C, is bent downward to protrude through a slot of lip 419 of base housing 18 when fastened thereto. Since base 18 preferably comprises cold drawn steel, nut 423 and screw 422 protrude through base 18 near its bottom where the metal is more rigid. A distance of at least two to three inches is provided between the top edge 421 (e.g., lip 419) and the axial position of screw-nut assembly 422, 423. Side base 411 is thus securely and removably



fastened to the side of base 18 via knurled head screws 422 and 424, as well as hook pins 426 and 428.

In actual use, the barbecue grill generally has a varying front-to-rear center of gravity during various load conditions, e.g., when adding briquettes, when briquettes burn off, or when adding or shifting meats. As clearly shown in Fig. 14A, the depending end of rear leg 413 is offset reward of the grill's center of gravity so as to reduce the likelihood of backward tipping upon opening lid 16 or loading foodstuff on various grids of the grill 10. The depending end of leg 413 extends beyond the edge 419 of base cavity 18. Without a construction to account for shifts in weight, difficulties are encountered with legs that fold on the bottom of the grill because, when providing side-to-side folding legs, the rear legs do not extend behind the plane of the rearward edge of the base 18, and when providing front-to-rear folding legs the legs are too short to provide adequate height of a portable grill of the desired size and dimensions. The present invention advantageously overcomes this problem by providing front and rear appendages of detachable legs that straddle the front-to-rear center of gravity of the grill.

Advantageously, and as seen in Fig. 14A, side bar 411 extends upwardly above of the top edge 421 of base 18 to provide a stop to restrict opening of side panel 17 that is hinged (not shown) to dome or lid 16. Side bar 411 also includes a third knurled head screw 426 (or other type of fastener) to secure side panel 17 in an open position and to prevent rotation of dome 16, which is pivotally connected to base 18.

A further advantage provided by the detachable leg member includes the top portion of side bar 411 being elongated from front to rear to span the approximate center-of-gravity range of grill 10 during its normal loading so that a user may grab and lift the grill about its center of gravity and move the unit in an about its area of use. Preferably, the top portion of side bar 11 extends about seven to eight inches. Although not limited to these dimensions, tubular metal of about 3/4 to 1.0 inches in diameter was used for the side bar and leg members in one embodiment of the invention. The rectangular base 18 is rectangular (as illustrated in Fig. 14D) and measures twenty-two by sixteen inches in its current design. Moreover, in one construction, base 18 comprises cold drawn sheet metal of mild steel of about one millimeter thickness which is drawn to a depth of about three and three-quarter inches. The resulting structure has torsional flexibility about an axis 415 (Fig. 14D) extending from side 18c to side 18d of the base thereby to provide self-leveling of each leg pair, i.e., four legs, under its own weight (about twenty to thirty pounds) when placed on a

non-planar surface. Fig. 14D symbolically illustrates base 18 having front 18a, rear 18b, and respective left and right sides 18c and 18d. Leg members are attached to sides 18c and 18d. It has been found that all four legs of grill 10 remain in contact with the ground when the side-to-side torsional flexibility of the housing 10 provides enables flexing to account for ground surface variations of about one half centimeter, or one to two centimeters, or more. Other materials, e.g., stainless steel or materials provide a minimum amount of torsion, may be used for the base 18.

Accordingly, the present invention provides a self-leveling grill having four legs. The present invention, among other things, also provides a leg assembly that is detachable, that is stable against rearward tipping, that provides both a stop to restrict opening of the grill's side panels and rotation of the grill lid or dome, and that provides an elongated handle spanning the approximate range of the grill's center of gravity.

As indicated herein, the shape of the leg may be tubular and/or that of an A-frame, a U-shape (inverted), V-shape (inverted) or parallelogram. A symmetrical shape, however, facilitates manufacturing since both sides have the same leg. Further, such legs may or may not include a cross-member brace, for example. The legs may be dimensioned to fit inside the base 18 of grill 10, or larger to provide more flexible use and operation of the grill. The principal advantage provided by these various shapes includes providing a rear appendage that extends rearward of the grill to improve stability against backward tipping, a relatively thin structure having a small volume and that fit inside the base of the grill if desired, and quick and convenient attachment and detachment to the grill. Other advantages described herein include the flexible nature of the base to provide self-leveling of the legs, an elongated handle spanning the front-to-rear center of gravity for convenient transport and movement, and a raised elongated handle for securing the side panels and the dome.

Side shelves (not shown) or additional handles (not shown) also may be removably provided with each leg construction described above simply by providing complementary interlocking attachment elements on the side shelf and leg members 412, 413.

While I describe my invention with reference to the above illustrative embodiments, the scope should not be limited. Many variations and modifications known to those ordinarily skilled in the art may be made without departing from the spirit of the invention, which is defined by the appended claims rather than by the exemplary embodiments described in the foregoing specification and drawings.

## Claims

1. A briquette-burning multi-level barbecue grill comprising:
  - a base cavity,
  - a top lid positionable upwardly about a rear of said base cavity,
  - a pair of sidewalls extending substantially vertically from the base cavity to define an oven-like region in front of said top lid between said sidewalls within and about said base cavity,
  - a firebox having a fuel chamber positionable substantially vertically but being backwardly inclined about a rear portion of said region,
  - a main cooking grid positionable horizontally about a frontal face near a lower portion of said firebox and between said sidewalls, and
  - a secondary cooking grid positioned horizontally about an upper portion of said firebox.
2. The multi-level barbecue grill as recited in claim 1, wherein said secondary cooking grid has at least a portion thereof positionable over the fuel chamber of firebox.
3. The multi-level barbecue grill as recited in claim 1 further including a mid-level cooking grid positionable horizontally across the face of said firebox between an upper and lower portion thereof between said sidewalls.
4. The multi-level barbecue grill as recited in claim 1, wherein said barbecue grill is collapsible and each of said sidewalls folds out from said top lid and includes a fastener to rigidly fasten each said sidewalls to a top portion of said base cavity.
5. The multi-level barbecue grill as recited in claim 4, including legs that have a portion thereof extendable outwardly of a rear plane of said base cavity whereby to improve stability against backward tipping.
6. The multi-level barbecue grill as recited in claim 1, wherein said firebox extends downwardly into said base cavity underneath said main cooking grid thereby to convect and radiate heat underneath said main cooking grid.
7. The multi-level barbecue grill as recited in claim 4, wherein at least one of said base cavity and said legs are arranged to provide a forward incline of the bottom of said base cavity to enable cooking grease to flow forward away from said firebox.
8. The multi-level barbecue grill as recited in claim 1, further including mating support elements that removably hold said firebox so that a frontal face thereof lies in a position that is backwardly inclined from about three to twenty degrees relative to at least one of said

cooking grids so as to provide heating laterally and underneath said at least one of said cooking grids and also to reduce the tendency of burning briquette ashes to fall onto said at least one of said cooking grids.

9. The multi-level barbecue grill as recited in claim 8, including mating lips of said base cavity and top lid have in inward bevel angle so as to provide compression sealing of said base cavity and top lid when closed upon each other.

10. The multi-level barbecue grill as recited in claim 8, wherein said top lid includes an inner shelf that provides support for said firebox in an inclined position and that prevent substances from falling behind said firebox.

11. The multi-level barbecue grill as recited in claim 1, wherein said sidewalls are spaced from respective sides of said firebox thereby providing thermal insulation between said firebox and said sidewalls.

12. The multi-level barbecue grill as recited in claim 11, wherein said sidewalls further include air passages to facilitate ventilation for oxidizing burning fuel and to assist in cooling said sidewalls.

13. The multi-level barbecue grill as recited in claim 11, wherein said sidewalls include rail guides for supporting at least one of said main grid, said mid-level grid, and said secondary grid.

14. The multi-level barbecue grill as recited in claim 1, wherein said main grid includes a series of upwardly facing troughs directionally extending between a front and rear portion of said base cavity, said main grid being inclined downwardly towards the front of said base cavity whereby said troughs channel grease drippings from cooking foods to a grease trough.

15. The multi-level barbecue grill as recited in claim 14, wherein said grease trough comprises a grease box located in or about said base cavity.

16. The multi-level barbecue grill as recited in claim 15, wherein said main grid includes lateral extensions about the respective sides of said firebox whereby to capture grease drippings from an upper grid located vertically above said lateral extensions.

17. The multi-level barbecue grill as recited in claim 1, wherein said firebox extends down into the base cavity thereby to radiate and convect heat underneath said main cooking grid.

18. The multi-level barbecue grill as recited in claim 1, further including a cover that mates with top and front peripheral edges of said sidewalls to form an oven-like enclosure

that retain heat thereby by transform said barbecue grill into an oven for baking, roasting, broiling and/or grilling.

19. The multi-level barbecue grill as recited in claim 8, further including side shelves attachable to the sides of said base cavity.

20. The multi-level barbecue grill as recited in claim 8, wherein said sidewalls include an insulating panel attached thereto, which provides an air spacing between inner and outer surfaces of said sidewalls.

21. A tabletop barbecue grill comprising:

- a base cavity,
- a top lid positionable upwardly near the rear of said base cavity,
- a pair of sidewalls extending vertically from the base cavity in front of said top lid thereby to define cooking area between said sidewalls about said base cavity,
- a firebox located near the rear of said base cavity and having a fuel chamber that is positionable substantially vertically but backwardly inclined,
- a main cooking grid positioned horizontally about a lower portion of a frontal face of said firebox, and
- a secondary cooking grid positioned horizontally near a mid-level or upper portion of said firebox.

22. The tabletop barbecue grill as recited in claim 21, wherein said secondary grid has at least a portion thereof positioned over the fuel chamber of firebox.

23. The tabletop barbecue grill as recited in claim 21, wherein said barbecue grill is collapsible and each of said sidewalls folds out from said top lid and includes a fastener to rigidly fasten each said sidewalls to a top portion of said base cavity.

24. The tabletop barbecue grill as recited in claim 21, further including short legs arranged to provide a forward incline of said base cavity to effect the flow of cooking grease away from said firebox.

25. The tabletop barbecue grill as recited in claim 21, further including supporting elements that hold said firebox so that a frontal face thereof is backwardly inclined relative to at least one of said cooking grid so as to provide heating from lateral and underside directions and to reduce the tendency of burning briquette ashes to fall onto said cooking grid.

26. The tabletop barbecue grill as recited in claim 21, wherein said top lid includes an inner shelf that provides support for said firebox in an inclined position and that prevent substances from falling behind said firebox.

27. The multi-level barbecue grill as recited in claim 21, wherein said sidewalls are spaced from the respective sides of said firebox thereby providing thermal insulation between said firebox and said sidewalls, and further, said sidewalls include insulating panels attached thereto which provide an air insulating space between inner and outer surfaces of the respective sidewalls.
28. The tabletop barbecue grill as recited in claim 21, wherein said main grid includes a series of upwardly facing troughs extending between a front and rear portion of said base cavity, said main grid being inclined downwardly towards the front of said base cavity whereby to channel grease drippings to a grease trough.
29. The multi-level barbecue grill as recited in claim 28, where said grease trough comprises a grease box located in or about said base cavity.
30. The multi-level barbecue grill as recited in claim 28, wherein said main grid laterally extends about the respective sides of said firebox whereby to capture grease drippings from an upper grid portion located vertically above said lateral extensions.
31. A gas-fired or briquette-burning multi-level barbecue grill comprising:  
a base cavity,  
a top lid positionable upwardly about a rear of said base cavity,  
a pair of sidewalls extending vertically from the base cavity in front of said top lid to define cooking area between said sidewalls within and about said base cavity, said sidewalls being hinged with at least one of said top lid and said base cavity and including an insulating panel to provide insulation between inner and outer surfaces of said sidewalls, said sidewalls further including respective rail guides for supporting cooking grids,  
respective fasteners on respective sides of one of the base cavity and top lid to rigidly fasten said sidewalls in a deployed position,  
a firebox having gas-fired heat radiating elements and being positionable substantially vertical about the rear portion of said base cavity,  
a main cooking grid positionable horizontally about a frontal face but above a lower portion of said firebox and between said sidewalls, and  
at least one supplemental grid that is supported by said rail guides horizontally across a face of said firebox.
32. The multi-level barbecue grill as recited in claim 31 wherein one of said supplemental cooking grids is positionable directly over said firebox to provide a region subjected to direct heating.

33. The multi-level barbecue grill as recited in claim 32, wherein said base cavity is arranged to provide a forward incline to effect the flow of cooking grease away from said firebox.
34. The multi-level barbecue grill as recited in claim 31, wherein said top lid includes an inner shelf that supports said firebox and that prevents substances from falling behind said firebox.
35. The multi-level barbecue grill as recited in claim 31, wherein said base cavity and top lid include mating lip that are inwardly beveled to provide spring-loaded sealing when the top lid is closed upon the base cavity.
36. The multi-level barbecue grill as recited in claim 31, wherein said main grid including a series of upwardly facing and substantially linear troughs directionally extending between a front and rear portion of said base cavity, said main grid being inclined downwardly towards the front of said base cavity whereby said troughs channel grease drippings from cooking foods to a grease trough.
37. The multi-level barbecue grill as recited in claim 36, where said grease trough comprises a grease box located in or about said base cavity.
38. The multi-level barbecue grill as recited in claim 36, wherein said main grid laterally extends about the respective sides of said firebox whereby to capture grease drippings from an upper grid located vertically above said lateral extensions.
39. The multi-level barbecue grill as recited in claim 31, including a cover that mates with top and front peripheral edges of said sidewalls thereby to form an oven-like enclosure about said main cooking grid.
40. The multi-level barbecue grill as recited in claim 39 wherein said firebox is inclined between three and twenty degrees from vertical whereby to provide heating from lateral and underside directions.
41. In combination with a vertical hearth barbecue grill, the improvement comprising:  
a supporting mechanism in said barbecue grill that removably supports a firebox so that a front facing thereof is backwardly inclined relative to a cooking grid located across the firebox thereby provide heating from lateral and underside directions and/or to reduce the likelihood of fuel ashes falling onto said cooking grid during avalanche of ashes from burning solid fuel.
42. A firebox defining a fuel chamber for ash-generating briquettes being adapted for use in a barbecue grill wherein the firebox is nearly vertically relative to at least one cooking

grid, said firebox comprising a bottom surface, a rear surface, respective side surfaces, an open top, an open frontal face that is backwardly inclined relative to a cooking grid positionable horizontally across said frontal face of said firebox.

43. In combination with a firebox for use with a barbecue grill wherein the firebox is substantially vertical and includes a back, respective sides, a bottom, and an open top thereby to define a fuel chamber and wherein said barbecue grill includes at least one cooking grid positionable horizontally between a pair of sidewalls and across the front of said firebox, an improvement comprising:

· a firebox support including at least one of a flange, tab, metal stamping, rib, plate, a cradle, a receptacle, pin, stud, stop, hook, screw, and bolt to support said firebox in a backwardly inclined position during cooking so as to provide a combination of direct and indirect heating and/or to reduce the likelihood of briquette ashes falling onto said at least one cooking grid, and

an ash reservoir within said firebox that is defined by a grate inside said firebox that permits ashes to pass but restricts passage of said briquettes.

44. The improvement recited in claim 43, further including a thermal barrier located laterally across the front of said firebox near a junction between a cooking grid and said front, whereby to reduce heat exposure to foods in close proximity thereof.

45. The improvement recited in claim 43, wherein said grate provides a reservoir area against an inside back wall of said firebox, whereby to provide additional insulation between oxidizing fuel and an external housing of said barbecue grill.

46. The improvement recited in claim 45 wherein said grate comprises a wire basket.

47. The improvement recited in claim 43, wherein said firebox further includes a receptacle for receiving a lifting handle near a lateral center of gravity of said firebox to facilitate removing said firebox from said barbecue grill to dump hot fuel remains.

48. The improvement recited in claim 43, wherein said firebox includes air vents in at least one of said sides and said back of said firebox.

49. The improvement recited in claim 48, wherein said air vents comprise sheet metal cutouts having downwardly inclined flanges over which ash residue falls during burning of fuel.

50. In a vertical hearth barbecue grill including a firebox that is substantially vertical, said barbecue grill including a base cavity, a lid that closes upon said base cavity, and a pair of



side panels extending upwardly of said base cavity between respective sides of said lid thereby to define a cooking area, the improvement comprising:

a cooking grid extending between said side panels laterally across a top portion of the firebox, the cooking grid being supported in a fixed position between the side panels and including an extension segment that moves between extended and non-extended positions whereby, in the extended position, the extension segment lies over the top portion of the firebox to provide cooking surface directly over the firebox and, in the non-extended position, the firebox is open to receive briquettes.

51. In combination with a vertical hearth barbecue grill including a firebox that is substantially vertical, the barbecue grill including a base cavity, a lid that closes upon the base cavity, and a pair of side panels extending upwardly of the base cavity between respective sides of the lid thereby to define a cooking area, each said side panels including slots for receiving extensions of a cooking grid, the improvement comprising:

a cooking grid extending between the side panels laterally across the cooking area and including extension members on respective ends thereof arranged to protrude into the slots of respective walls of the side panels thereby to support the cooking grid in a fixed position in the cooking area across a face of the firebox, the extension members extending in a horizontal plane of the cooking grid so as to attain minimal volume for storing the cooking grid.

52. In combination with a vertical hearth barbecue grill including a firebox that is substantially vertical, the barbecue grill including a base cavity, a lid that closes upon the base cavity, and a pair of side panels extending upwardly of the base cavity between respective sides of the lid thereby to define a cooking area, each said side panels including slots for receiving extensions of a cooking grid, the improvement comprising:

a cooking grid adapted to extend between the side panels laterally across the cooking area, a front portion of said cooking grid being inclined upwardly to reduce the likelihood of food items rolling off said cooking grid.

53. In a vertical hearth barbecue grill including a firebox that is substantially vertical, the barbecue grill including a base cavity, a lid that closes upon the base cavity, and a pair of side panels extending upwardly of the base cavity between respective sides of the lid thereby to define a cooking area, each said side panels including slots for receiving extensions of a cooking grid, the improvement comprising:

said side panels including slots for receiving extension members of a cooking grid, said slots including a horizontal portion for receiving a horizontal portion of said extension members and a drop-down vertical portion for locking said cooking grid in a fixed position.

54. The improvement as recited in claim 53, wherein each of said side panels further includes at least one flex tab at a lower portion thereof that flexes outwardly and inwardly to support a main cooking grid.

55. In a vertical hearth barbecue grill the includes a firebox that is substantially vertical, said barbecue grill having a base cavity, a lid that closes upon the base cavity, and a pair of side panels extending upwardly of the base cavity between respective sides of the lid thereby to define a cooking area, the improvement comprising:

a slip cover adapted to slip over the firebox to form a substantially air tight seal with the firebox to help extinguish burning coals.

56. In a vertical hearth barbecue grill that includes a firebox that is substantially vertical, the barbecue grill including a base cavity, a lid in the form of a dome that closes upon the base cavity, and a pair of side panels extending upwardly of the base cavity between respective sides of the lid to define a cooking area, the improvement comprising:

a heat shield located in said dome adapted to extend (flex or rotate on a hinged) outwardly over at least a portion of the top of said firebox upon opening said dome and to lie inwardly within said dome when said dome is closed upon said base cavity.

57. In a vertical hearth barbecue grill that includes a firebox that is substantially vertical, the barbecue grill including a base cavity, a lid in the form of a dome that closes upon the base cavity, and a pair of side panels extending upwardly of the base cavity between respective sides of the lid thereby to define a cooking area, the improvement comprising:

an oven cover supported by the side panels that substantially encloses the cooking area so as to form an oven, the oven cover including a controllable damper that vents said cooking area in order to help control at least one of temperature and air flow through said cooking area.

58. The improvement recited in claim 57 wherein the oven cover further includes a temperature gauge that indicates the temperature within said cooking chamber.

59. A broiler pan cooking grid for use in a barbecue grill that supports said grid in an inclined position, said grid comprising:

an upper layer of [material] sheet metal including a plurality of raised mounds being upwardly convexed and a plurality of cutouts being disposed lower than said mounds that permit pass through of liquids to a lower layer of sheet metal,

said lower layer of sheet metal including a series of troughs stamped therein that are disposed beneath said cutouts of said upper layer of sheet metal, [and]

a plurality of stiffening rods interposed between and attached to said upper and lower layers of sheet metal thereby to form a substantially thin and rigid interconnected assembly for use as a substitute cooking grid in a said barbecue grill, and

said upper and lower layers of sheet metal being disposed relative to each other to permit convection of air generally upward through openings in said lower layer and said cutouts in said upper layer while at the same time catching grease drippings from said upper layer into said troughs of said lower layer.

60. The broiler pan cooking grid as recited in claim 59, said cutouts in said upper layer of sheet metal comprises first and second rows of longitudinal slots with interconnecting webs between respective slots in said first and second rows, and wherein said series of stiffening rods between said upper and lower lie underneath a front edge, a rear edge, and said webs whereby to shield said stiffening rods from view.

61. In a barbecue grill having a housing and providing a source of heat, an improvement comprising a water tank that holds a supply of water, a heat exchanger in communication with said tank, said heat exchanger being supported by said housing and disposed in heat transfer proximity of said source of heat, an opening in at least one of said water tank and said heat exchanger for receiving a supply of water, and an output in communication with at least one of said heat exchanger and said water tank for delivering hot water heated by said source of heat.

62. The improvement recited in claim 61, further comprising an output valve for controlling the flow of water delivered by said output.

63. The improvement recited in claim 61, further comprising a funnel device attached to said opening for channeling water to at least one of said water tank and said heat exchanger.

64. The improvement recited in claim 61, wherein said heat exchanger comprises a material having a relatively high heat transfer characteristic.

65. The improvement recited in claim 64, wherein said material comprises copper.

66. The improvement recited in claim 61, wherein said source of heat has an upper portion and a lower portion, and said water tank is located near the upper portion of said source of heat.
67. The improvement recited in claim 61, wherein said source of heat has an upper portion and a lower portion and said water tank is located near the lower portion of said source of heat.
68. In a barbecue grill that provides a source of heat, an improvement comprising a water tank located in heat transfer proximity of said source of heat, an opening in said water tank for receiving a supply of water, and a discharge port in said tank for delivering water heated by said source of heat.
69. The improvement recited in claim 68, further comprising a cup device attached to said opening for channeling water to said tank and a discharge valve for controlling the flow of water delivered by said discharge port.
70. In a barbecue grill that provides a source of heat, an improvement comprising a heat exchanger coil located near said source of heat, an opening in said heat exchanger coil for receiving water, and a discharge portion of said heat exchanger coil for delivering water heated by said source of heat as water flows through said heat exchanger coil.
71. The improvement recited in claim 70, further comprising an input device for channeling water to said heat exchanger coil.
72. In a barbecue grill that provides a source of heat, an improvement comprising a tank located near said source of heat, an input in said tank for receiving a fluid, a pressure valve that pressurizes said tank when heated by said source of heat, and a discharge port for delivering pressurized gas for producing a source of mechanical power.
73. The improvement as recited in claim 72, wherein said fluid comprises water, said gas comprises steam, and said mechanical power drives a rotisserie associated with said barbecue grill.
74. The improvement as recited in claim 72, wherein said mechanical power produces electrical energy.
75. In a barbecue grill that supports a firebox that provides a source of heat, an improvement comprising a water tank located in heat transfer proximity of said source of heat, an opening in said tank for receiving water, a discharge port for delivering water heated by said source of heat, and a valve for controlling the flow of water from said tank.

76. In a vertical hearth barbecue grill having a housing that supports a firebox in a substantially vertical position, said firebox providing a source of heat, an improvement comprising a water tank located in heat transfer proximity of said source of heat, an opening in said tank for receiving water, and a discharge port for delivering water heated by said source of heat.

77. A method of producing hot water from a barbecue grill, comprising:  
providing a source of heat in said barbecue grill,  
providing a heat exchanger in heat transfer proximity of said source of heat,  
passing water through said heat exchanger, and  
discharging heated water from said heat exchanger.

78. A method of producing hot water from a barbecue grill, comprising:  
providing a tank in said barbecue grill,  
filling said tank with water,  
subjecting said tank to a source of heat in said barbecue grill, and  
extracting hot water from said tank.

79. A barbecue grill having a front-to-rear center of gravity that varies in use, said grill comprising:  
a generally rectangular base having a front, rear and respective sides; a  
detachable leg member for each side of the grill, said leg member having an elongated upper span of an upper segment and respective front and rear downwardly extending appendages, the elongate upper span traversing an approximate front-to-rear center of gravity range of the grill; and

an interlocking mechanism on each side of the rectangular base that interlocks with at least a portion of the upper segment of each leg member, said interlocking mechanism including a fastener that fastens the upper segment of the leg member to a side of the base, the fastener including securing points at respective upper and lower portions of the side of the base,

each of the leg members being attached at a front-to-rear location of the side of the base so that at least the rear appendage of said leg member extends rearward of the base whereby to avoid rearward tipping of the grill.

80. The barbecue grill as recited in claim 79, wherein the rectangular base is flexible and has a side-to-side axial torsional flexibility to permit self-leveling of said leg members on a surface having at least one-half centimeter in variation.

81. The barbecue grill as recited in claims 79, wherein each leg member is segmented into at least front and rear appendages and a side bar that attaches to the base.
82. The barbecue grill as recited in claims 81, wherein the upper span of the leg member is located above the rectangular base to provide a stop to secure and restrict opening of side panels pivotally attached to the barbecue grill.
83. The barbecue grill as recited in claim 79, wherein each leg member has a shape including one of an inverted A-shape, a U-shape, a trapezoid, a parallelogram, and a combination thereof, with or without a cross-member brace.
84. The barbecue grill as recited in claim 79, wherein each leg member is angled outwardly from the base when attached thereto in order to provide greater side-to-side stability.
85. A leg member and an attachment structure for a barbecue grill having a generally rectangular housing, said leg member comprising a front appendage, a rear appendage, and an elongated upper span that serves as a handle traversing a center-of-gravity range of said grill, said attachment structure comprising an interlocking mechanism on each side of the rectangular housing that interlocks with at least an upper segment of the leg member and a fastener that clamps the leg member in place so that at least a portion of the rear appendage extends rearward of the rectangular housing of the grill and the elongated upper span traverses the center-of-gravity range of the grill.
86. The leg member as recited in claim 85, wherein the leg member is segmented front and rear appendages.
87. The leg member as recited in claim 85, wherein the rectangular base is flexible to provide self-leveling of the leg members on a surface having at least one-half centimeter in variation.
88. The leg member as recited in claim 85, wherein the leg assembly comprises stamped sheet metal and includes rolled-up edges to increase resistance to lateral flexing.
89. A barbecue grill having a generally rectangular base and a lid that mates with the base, said grill having a front-to-rear center of gravity that varies during various load conditions, rigid leg members that attach to respective sides of the base, each of said leg members having an elongated upper span and appending front and rear appendages, the elongated upper span providing a handle to grasp the barbecue grill when attached thereto and being adapted to attach to at least an upper portion and a lower portion of the side of the

base at a front-to-rear location thereof so that the front and rear appendages of each leg members straddle the front-to-rear center of gravity of the grill.

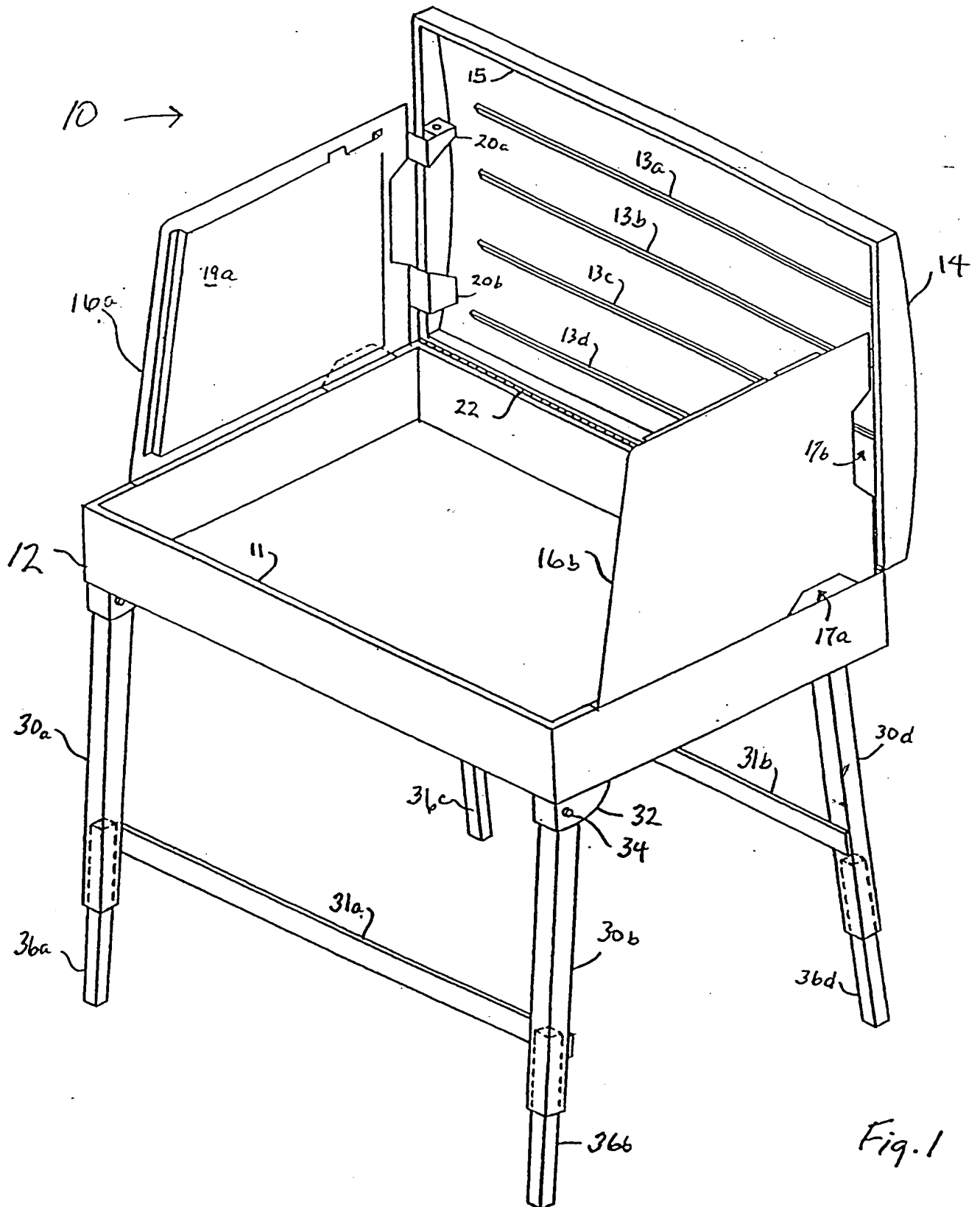
90. The barbecue grill as recited in claim 89, wherein each leg member comprise an A-frame structure which includes a cross-member span interconnecting the appendages.

91. The barbecue grill as recited in claim 89, wherein attachment of the upper span to the side of the base comprises a complementary mating attachment structure.

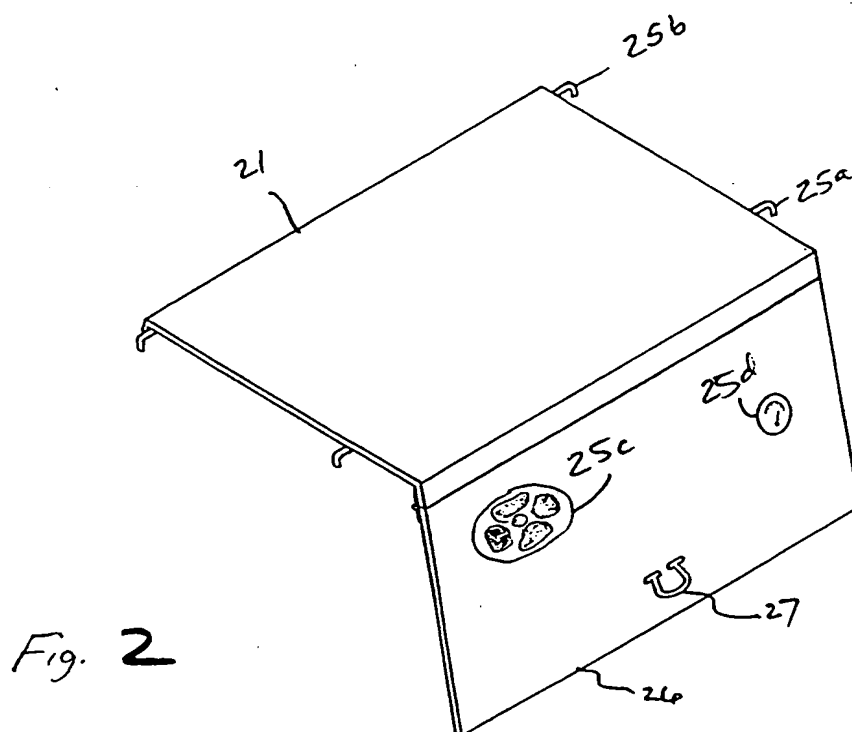
92. The barbecue grill as recited in claim 90, wherein an elongated rigid flange fixedly attached to the side of the base forms a slot into which an edge portion of the upper span inserts.

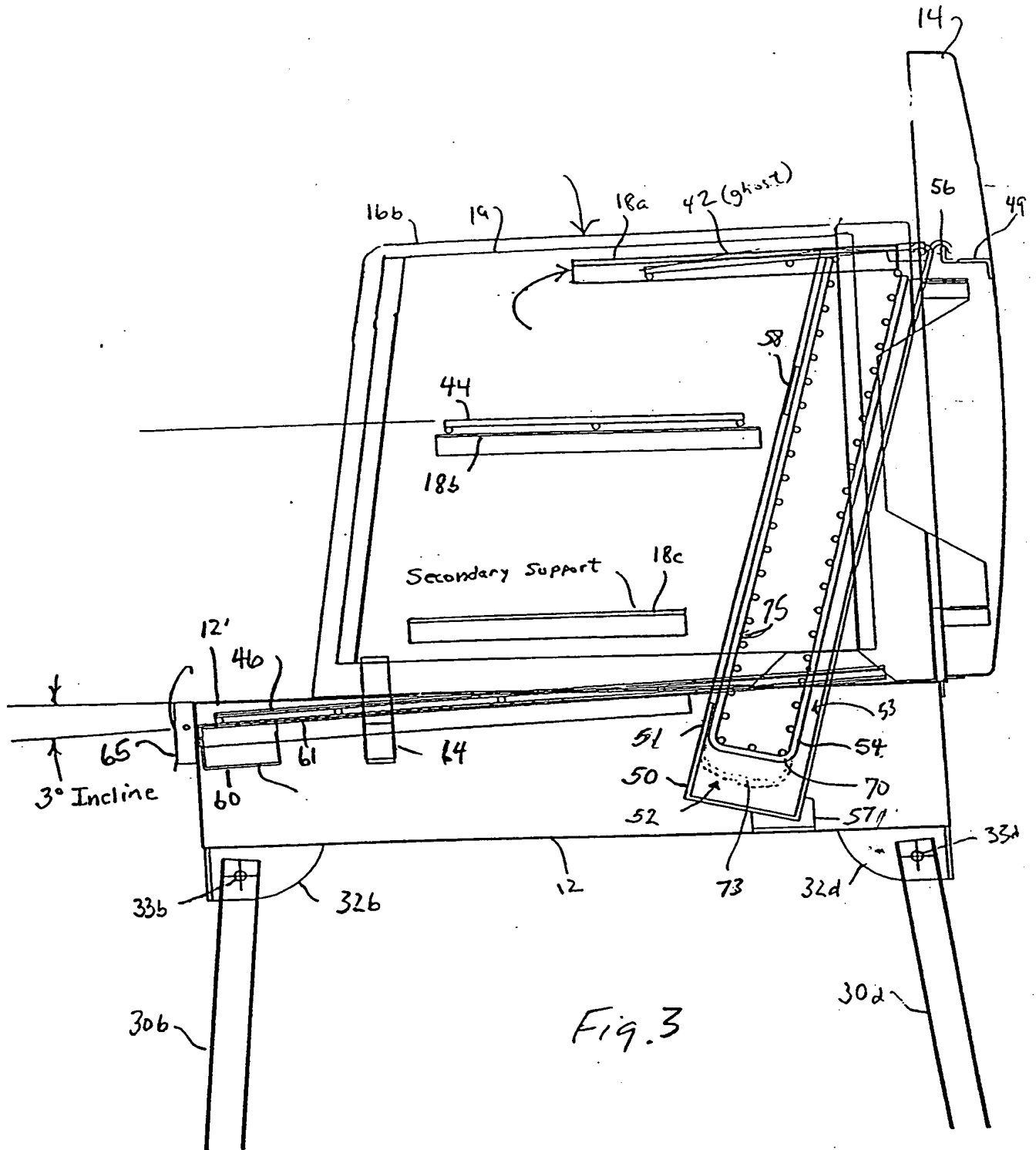
93. The barbecue grill as recited in claim 92, wherein the elongated rigid flange extends substantially between the front and rear extremities of the sides of the base so as to achieve maximum resistance against side-to-side flexing of the leg members when attached to the base.

94. The barbecue grill recited in claim 89, wherein the leg member comprises tubular metal that is segmented into an upper span comprising a side bar and respective front and rear appendages, the lower portions of the side bar being bent outwardly from said base to support the appendages at an outwardly angled position.









Main Grille

486

1/8" Channels

48a

490

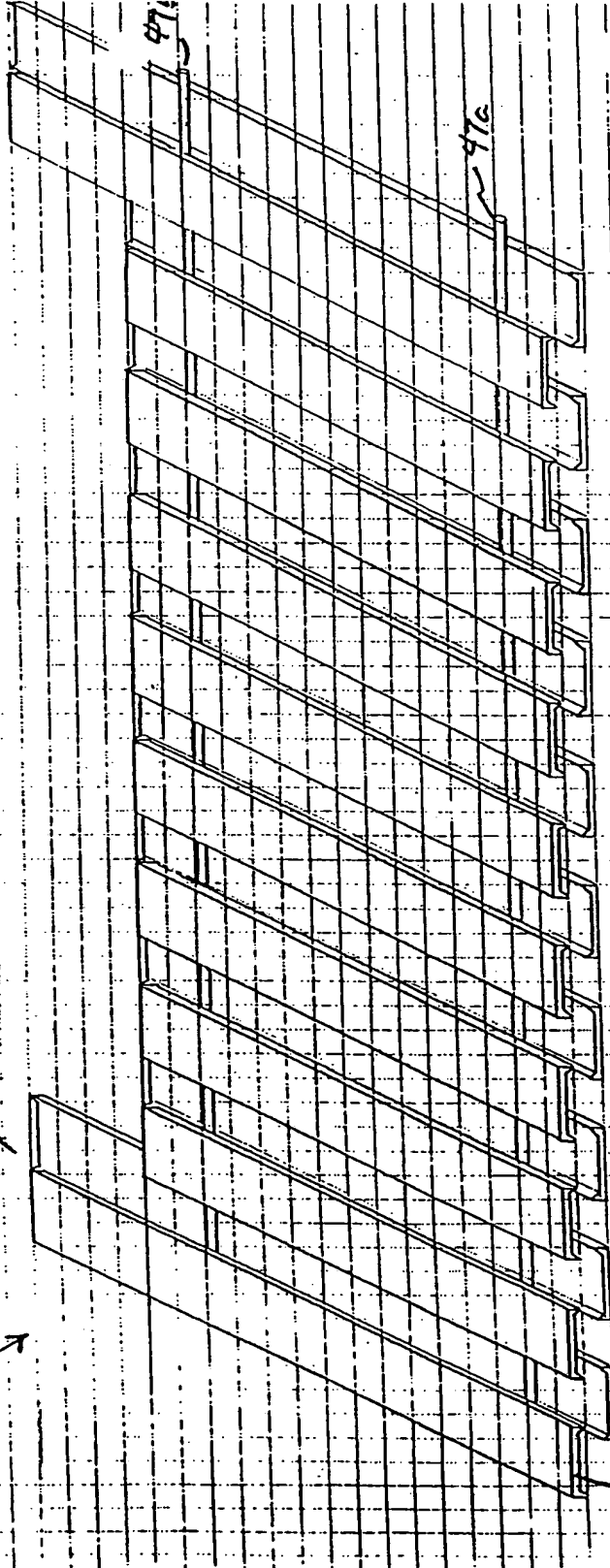
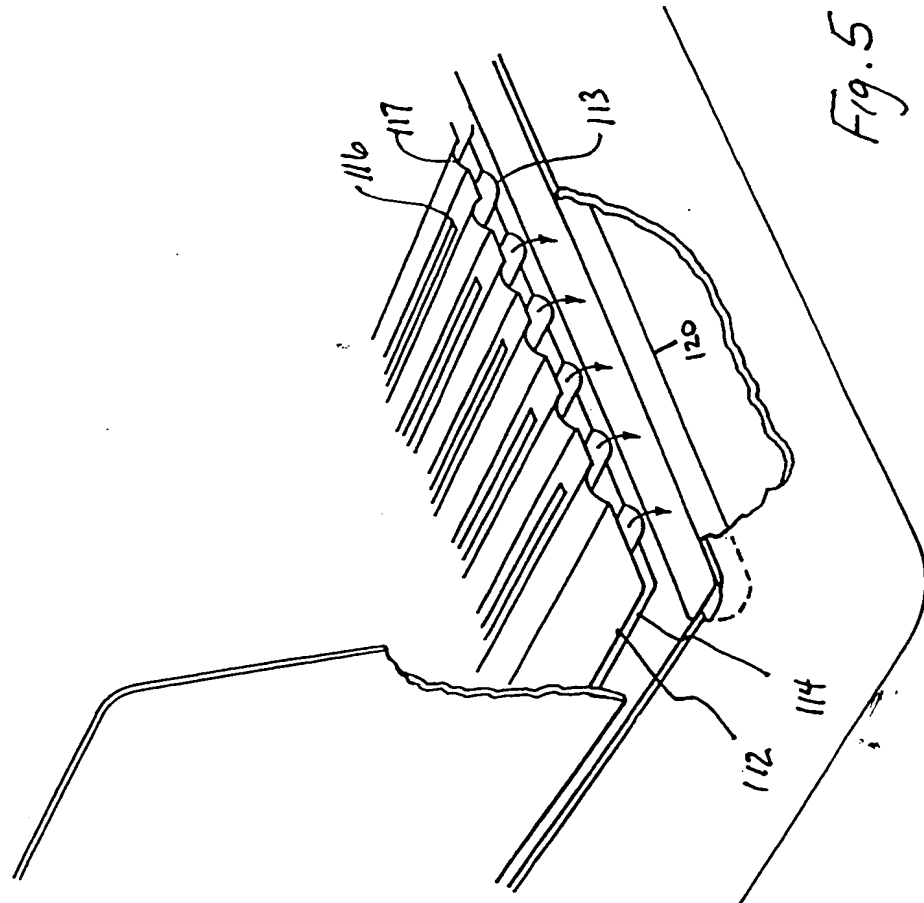
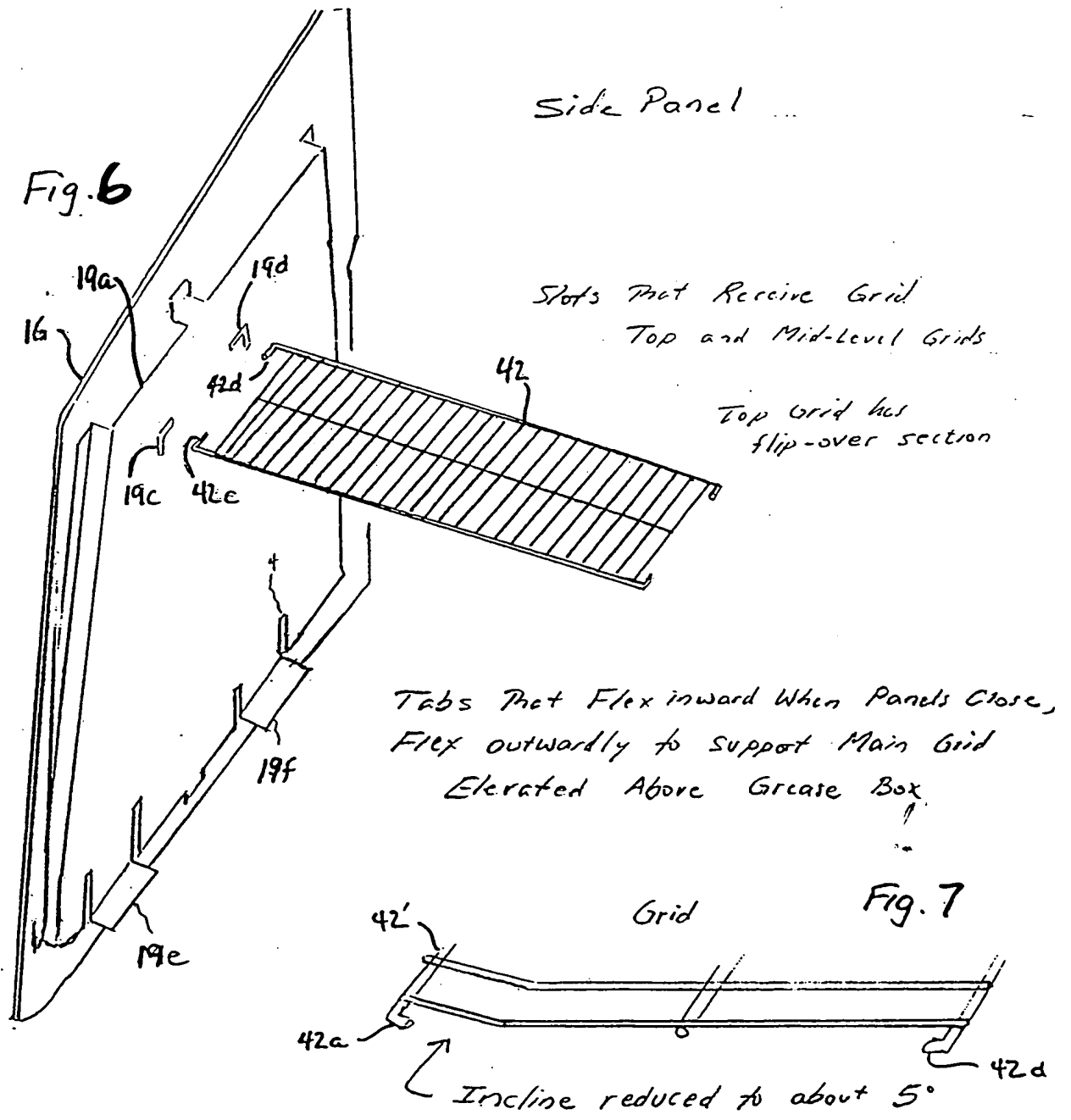
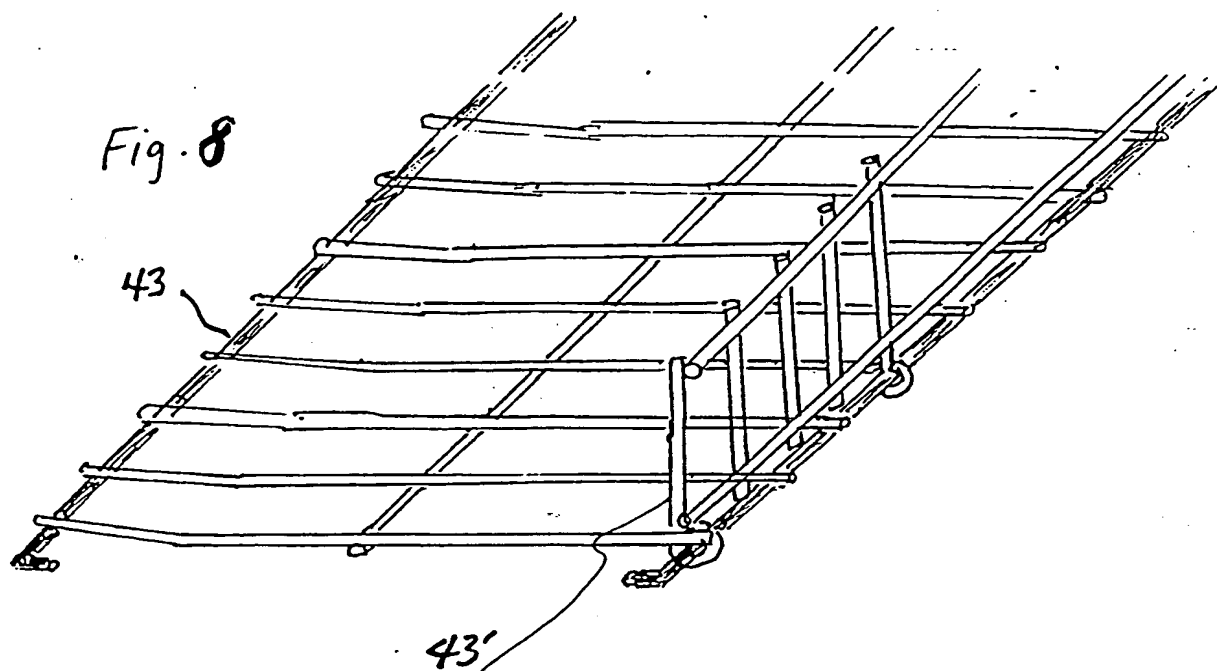


Fig. 4



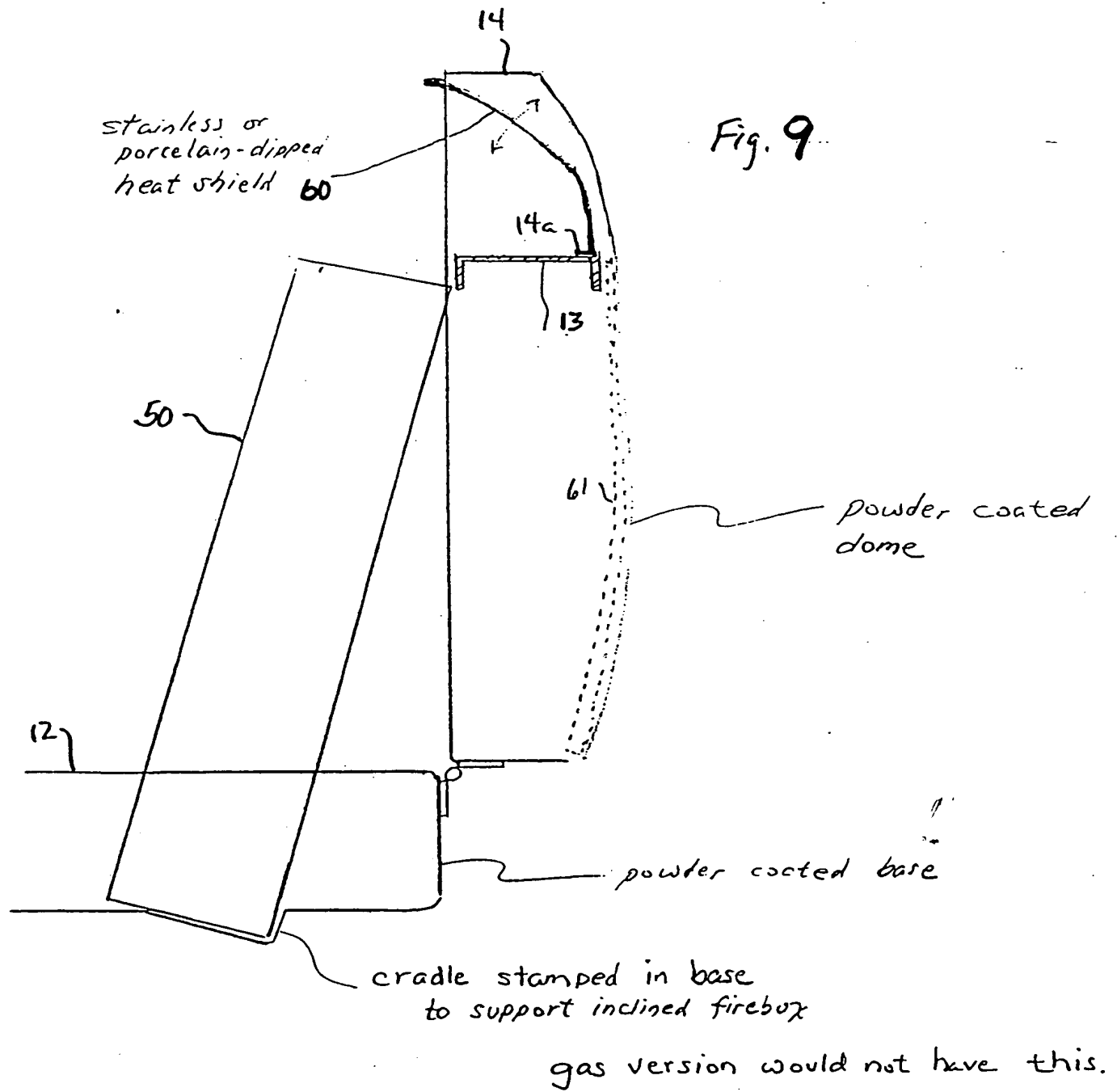


Top Grid



This rotates to fold over on  
top of firebox - to rest on shelf.

Rotated up to add coals - briquettes.



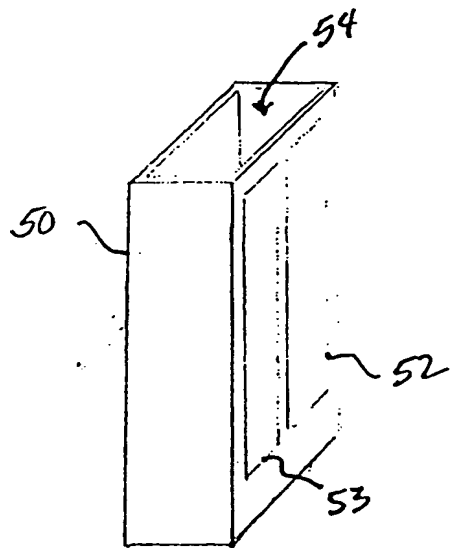


Fig. 10A

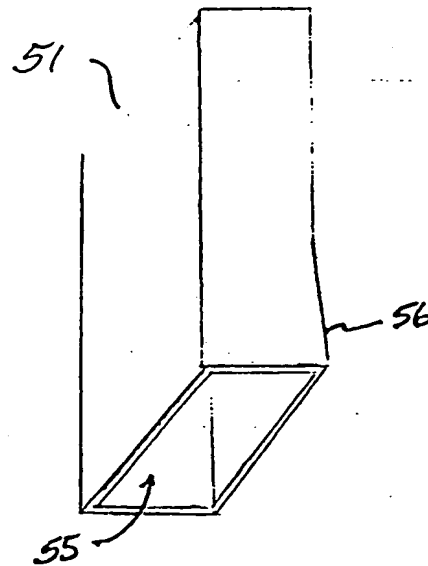


Fig. 10B

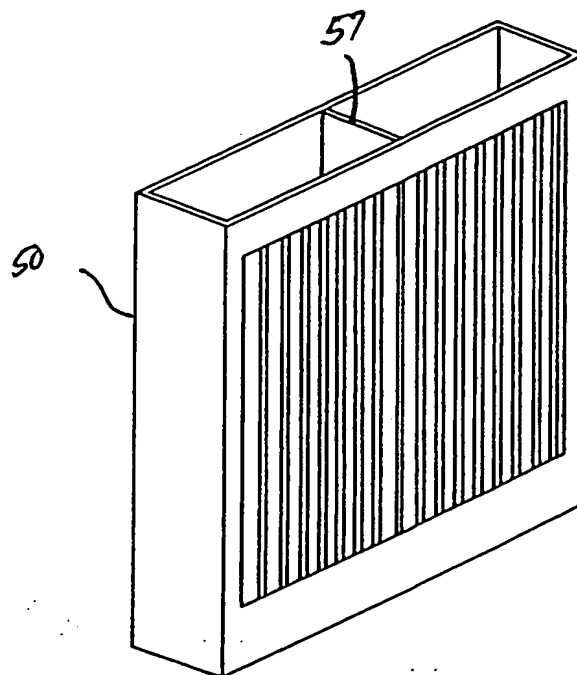


Fig. 10C



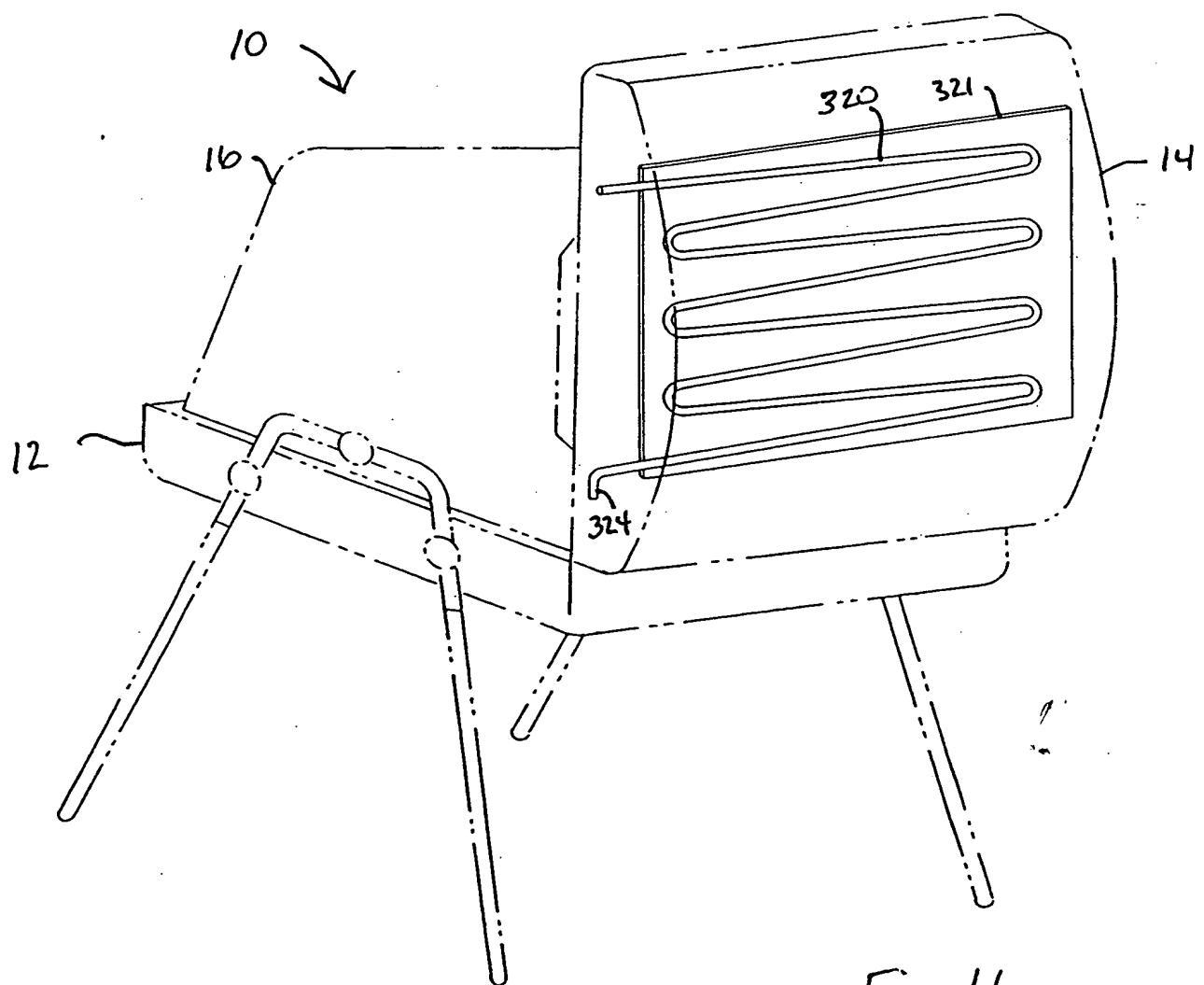


Fig. 11

Fig. 12A

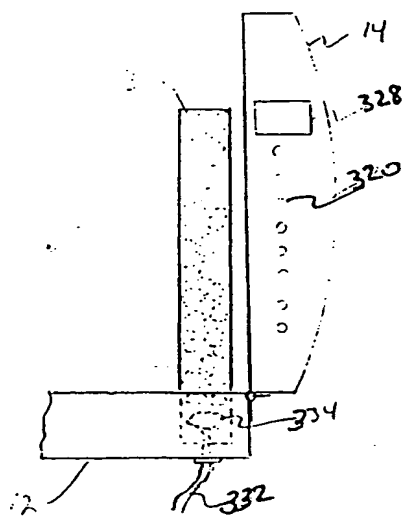


Fig. 12B

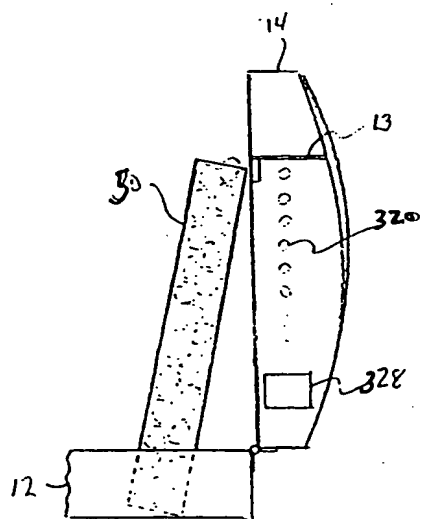
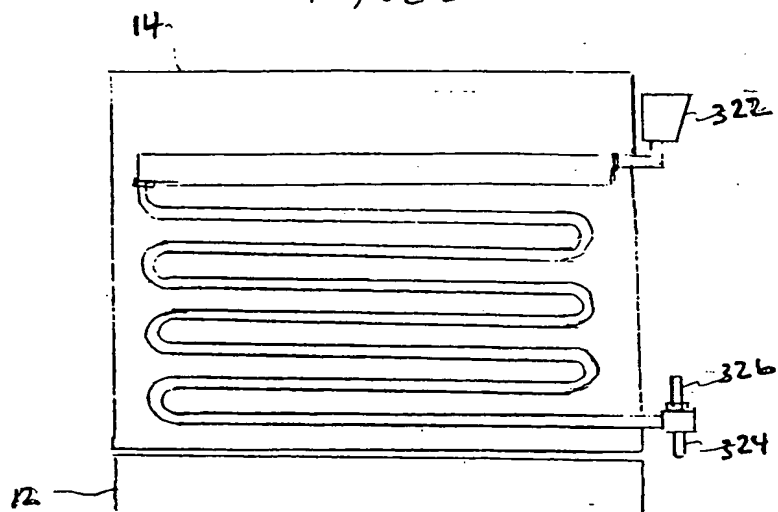


Fig. 13A

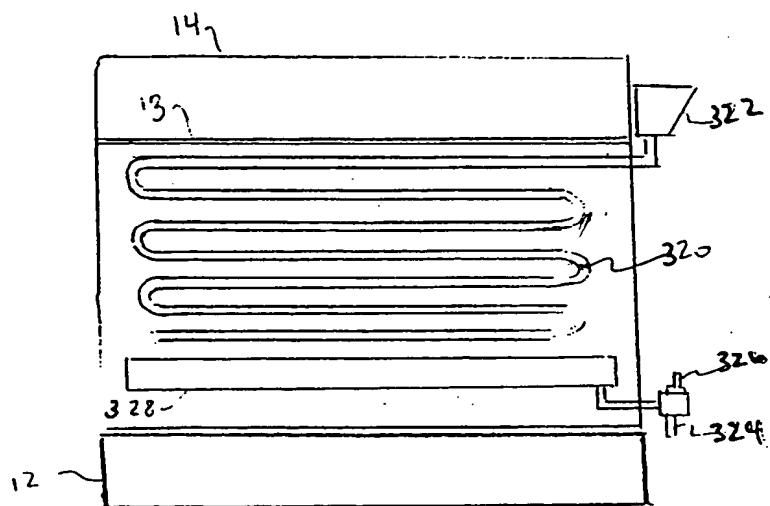
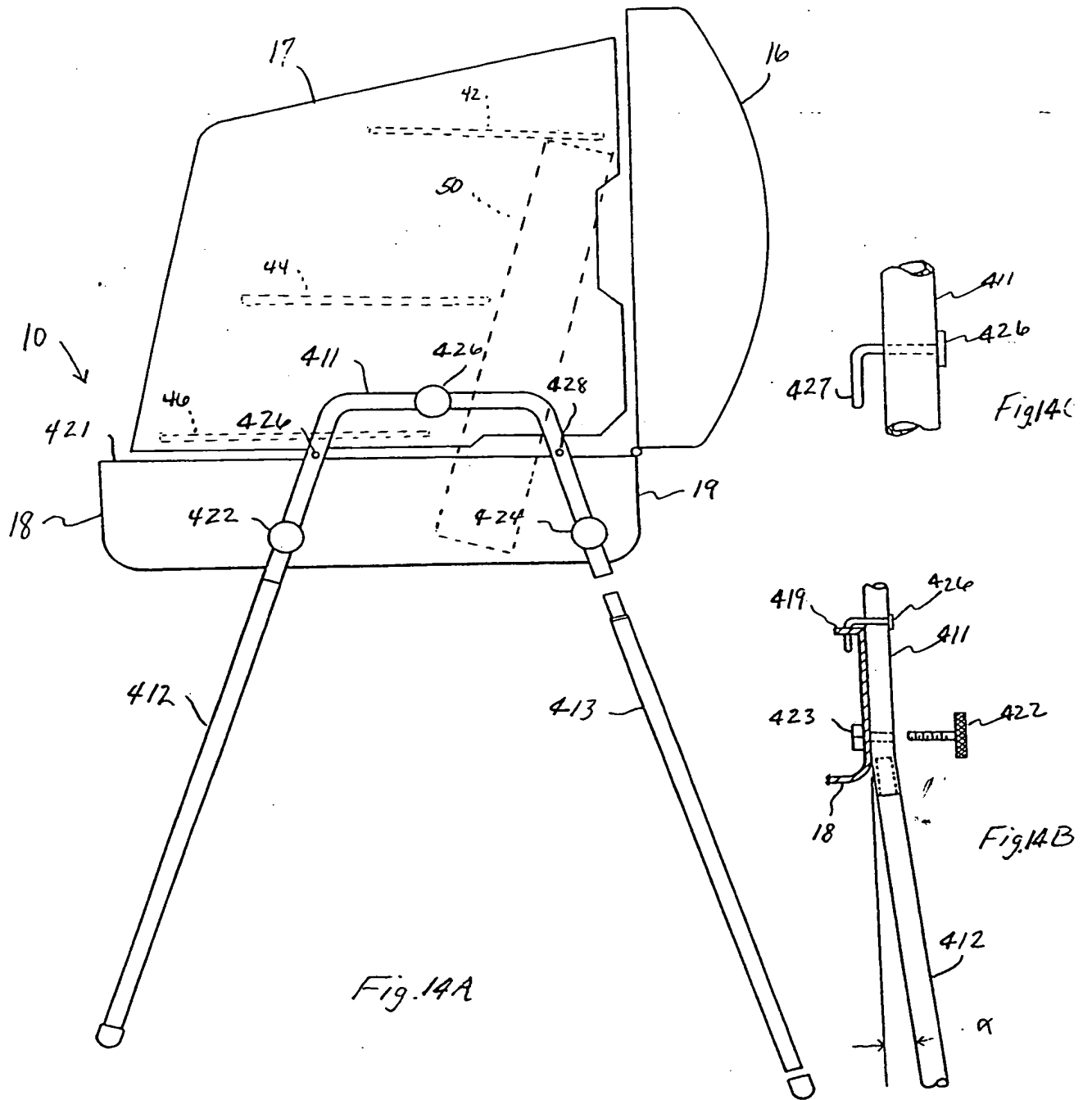


Fig. 13B



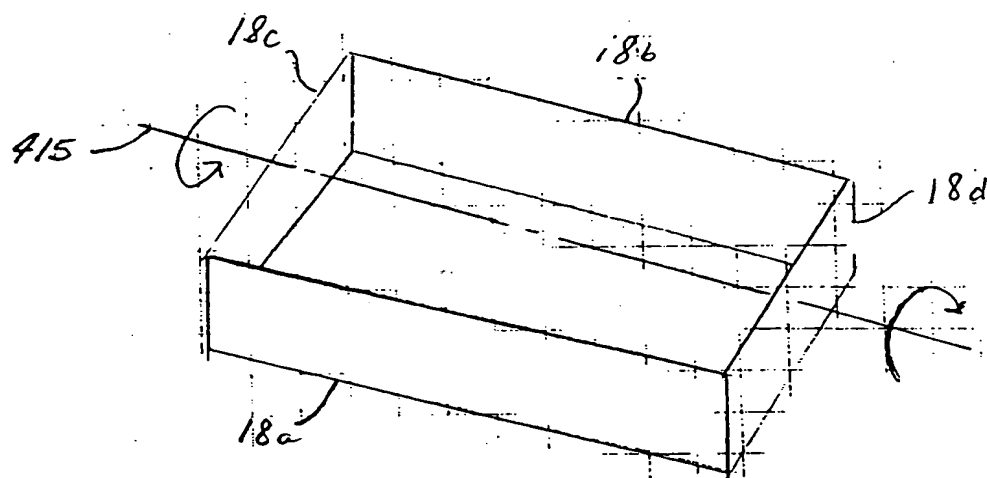


Fig. 14D

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US00/16256

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :A47J 37/00

US CL :126/25R, 9R; 99/340

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 126/25R, 9R, 5, 304A, 305, 306,304R, 42; 99/340, 385, 389, 390, 339, 400, 401, 444, 445, 446, 448, 449

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
None

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS search terms: heat shield, grid, up turned edge

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ----- Y	US 5,947,007 A (O'Grady et al) 07 September 1999, col. 7, lines 49-67.	41 ----- 1-9, 11-15, 17, 19, 21-25, 28,29, 31-48
X ----- Y	US 5,431,093 A (Dodgen) 11 July 1995, col. 3, lines 16-56.	1-3, 8, 11,13, 21, 22, 25, 41-48 ----- 6, 9, 17, 24
X	US 5,937,768 A (ATWOOD) 17 August 1999, col. 3, lines 1-49.	61, 62, 64, 66, 67, 70, 71, 77

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
*A* document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
*E* earlier document published on or after the international filing date	*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*G* document member of the same patent family
*O* document referring to an oral disclosure, use, exhibition or other means	
*P* document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 17 OCTOBER 2000	Date of mailing of the international search report 13 NOV 2000
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer IRA LAZARUS <i>Diane Smith</i> Telephone No. (703) 308-0861

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US00/16256

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---- Y	US 4,672,944 A (CURRY) 16 June 1987, col. 2, lines 40-50.	61, 62, 64-67, 70, 71, 77 ----- 63
X ---- Y	US 3,809,051 A (GIROUX) 07 May 1974, col. 2, lines 64-68	68, 75-78 ----- 69
X ----- Y	US 2,813,478 A (POPPLE) 19 November 1957, col. 1, lines 66-72.	72, 73 ----- 74
Y	US 5,823,174 A (ANDRESS) 20 October 1998, col. 2, lines 19-65.	1-9, 11-15, 17, 19, 21, 22-25, 28, 29, 31, 41, 42, 43, 44, 50, 51, 57, 58
Y	US 2,885,950 A (STOLL et al) 12 May 1959, col. 1, lines 19-35.	1, 6, 8, 11, 12, 17, 21, 25, 31, 41, 42, 43, 44
Y	US 5,259,299 A (FERRARO) 09 November 1993, col. 2, lines 52-64.	14, 15, 28, 29
Y	US 5,241,948 A (THIBODEAU) 07 September 1993, col. 2 lines 4-28.	7, 24.
Y	US 4,730,597 A (HOTTENROTH et al) 15 March 1988, col. 3, lines 40-59.	31
Y	US 5,261,388 A (WRIGHT et al) 16 November 1993, col. 3 lines 55-62.	12, 58
Y	US 3,200,806 A (GOLDSTEIN) 17 August 1965, col. 3, lines 19-25 and Figure 1.	50
Y	US 3,230,948 A (SCHMITT) 25 January 1966, col. 2 lines 1-25.	19
Y	US 4,553,523 A (STOHRER JR) 19 November 1985, col. 1 lines 1-40.	51
Y	US 5,105,726 A (LSKER) 21 April 1992, col. 1, lines 1-30.	53
Y	US 5,782,168 A (KRINAK) 21 July 1998, col. 2, lines 1-20.	55

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US00/16256

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to cl
Y	US 3,175,549 A (BERGSTEN) 30 March 1965, col. 4, lines 45-71.	4, 5, 7, 23, 5
Y	US 4,646,711 A (OLIPHANT) 03 March 1987, col. 1, lines 56-69 and col. 2, lines 1-54.	57, 79-94
Y	US 2,940,381 A (COTTONGIM et al) 14 June 1960, col. 4, lines 34-60.	59, 60
Y	US 4,608,917 A (FAABORG) 02 September 1986, col. 4, lines 13-35.	59, 60
Y	US 5,839,361 A (RICHTER) 24 November 1998, col. 1, lines 50-60 and col. 4 lines 51 to 63.	59, 60
Y	US 5,396,878 A (QUIST) 14 March 1995, col. 4, lines 20-30.	63, 69
Y	US 2,515,521 A (LOFFREDO) 18 July 1950, col. 2, lines 31-38.	7, 79-94
Y	US 5,678,531 A (BYERS et al) 21 October 1997, col. 2, lines 43-65.	7, 79-94

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US00/16256

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Please See Extra Sheet.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.  
☐ No protest accompanied the payment of additional search fees.



**BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING**

This ISA found multiple inventions as follows:

This application contains the following inventions or groups of inventions which are not so linked as to form a single inventive concept under PCT Rule 13.1. In order for all inventions to be searched, the appropriate additional search fees must be paid.

Group I claims 1-58 drawn to barbecue grill having base cavity, lid, sidewalls, firebox, and cooking grid.

Group II claims 59, 60 drawn to a boiler pan.

Group III claims 61-78 drawn to combination barbecue grill and water tank.

Group IV claims 79-94 drawn to leg supports for barbecue grill.

The inventions listed as Groups I, II, III, IV do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: Group I drawn to barbecue grill with base cavity, lid, sidewalls, firebox, cooking grid each having specific inventive features. Groups II, III, IV do not have those elements nor their specific inventive features. Group II drawn to broiler pan having specific inventive features. Groups I, III, IV are not drawn to a broiler pan and therefore do not have those specific inventive features of the broiler pan. Group III drawn to combination barbecue grill and water tank with specific features. Groups I, II, IV are not drawn to the combination and therefore do not have those specific inventive features. Group IV drawn to legs with specific inventive features for a barbecue grill. Groups I, II, III are not drawn to legs of a barbecue grill and therefore do not have those specific inventive features.